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[Rapid Review]

Non-pharmacological measures implemented in the setting of long-term care facilities to prevent SARS-CoV-2 infections and their consequences: a rapid review

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ABSTRACT

Background

Starting in late 2019, COVID-19, caused by the novel coronavirus SARS-CoV-2, spread around the world. Long-term care facilities are at particularly high risk of outbreaks, and the burden of morbidity and mortality is very high among residents living in these facilities.

Objectives

To assess the effects of non-pharmacological measures implemented in long-term care facilities to prevent or reduce the transmission of SARS-CoV-2 infection among residents, staff, and visitors.

Search methods

On 22 January 2021, we searched the Cochrane COVID-19 Study Register, WHO COVID-19 Global literature on coronavirus disease, Web of Science, and CINAHL.

We also conducted backward citation searches of existing reviews.

Selection criteria

We considered experimental, quasi-experimental, observational and modelling studies that assessed the effects of the measures implemented in long-term care facilities to protect residents and staff against SARS-CoV-2 infection. Primary outcomes were infections, hospitalisations and deaths due to COVID-19, contaminations of and outbreaks in long-term care facilities, and adverse health effects.

Data collection and analysis

Two review authors independently screened titles, abstracts and full texts. One review author performed data extractions, risk of bias assessments and quality appraisals, and at least one other author checked their accuracy. Risk of bias and quality assessments were conducted using the ROBINS-I tool for cohort and interrupted-time-series studies, the Joanna Briggs Institute (JBI) checklist for case-control studies, and a bespoke tool for modelling studies. We synthesised findings narratively, focusing on the direction of effect. One review author assessed certainty of evidence with GRADE, with the author team critically discussing the ratings.

Main results

We included 11 observational studies and 11 modelling studies in the analysis. All studies were conducted in high-income countries.

Most studies compared outcomes in long-term care facilities that implemented the measures with predicted or observed control scenarios without the measure (but often with baseline infection control measures also in place). Several modelling studies assessed additional comparator scenarios, such as comparing higher with lower rates of testing.

There were serious concerns regarding risk of bias in almost all observational studies and major or critical concerns regarding the quality of many modelling studies. Most observational studies did not adequately control for confounding. Many modelling studies used inappropriate assumptions about the structure and input parameters of the models, and failed to adequately assess uncertainty.

Overall, we identified five intervention domains, each including a number of specific measures.

Entry regulation measures (4 observational studies; 4 modelling studies)
Self-confinement of staff with residents may reduce the number of infections, probability of facility contamination, and number of deaths. Quarantine for new admissions may reduce the number of infections. Testing of new admissions and intensified testing of residents and of staff after holidays may reduce the number of infections, but the evidence is very uncertain. The evidence is very uncertain regarding whether restricting admissions of new residents reduces the number of infections, but the measure may reduce the probability of facility contamination. Visiting restrictions may reduce the number of infections and deaths. Furthermore, it may increase the probability of facility contamination, but the evidence is very uncertain. It is very uncertain how visiting restrictions may adversely affect the mental health of residents.

Contact-regulating and transmission-reducing measures (6 observational studies; 2 modelling studies)
Barrier nursing may increase the number of infections and the probability of outbreaks, but the evidence is very uncertain. Multicomponent cleaning and environmental hygiene measures may reduce the number of infections, but the evidence is very uncertain. It is unclear how contact reduction measures affect the probability of outbreaks. These measures may reduce the number of infections, but the evidence is very uncertain. Personal hygiene measures may reduce the probability of outbreaks, but the evidence is very uncertain.
Mask and personal protective equipment usage may reduce the number of infections, the probability of outbreaks, and the number of deaths, but the evidence is very uncertain. Cohorting residents and staff may reduce the number of infections, although evidence is very uncertain. Multicomponent contact -regulating and transmission -reducing measures may reduce the probability of outbreaks, but the evidence is very uncertain.

Surveillance measures (2 observational studies; 6 modelling studies)
Routine testing of residents and staff independent of symptoms may reduce the number of infections. It may reduce the probability of outbreaks, but the evidence is very uncertain. Evidence from one observational study suggests that the measure may reduce, while the evidence from one modelling study suggests that it probably reduces hospitalisations. The measure may reduce the number of deaths among residents, but the evidence on deaths among staff is unclear.
Symptom-based surveillance testing may reduce the number of infections and the probability of outbreaks, but the evidence is very uncertain.

Outbreak control measures (4 observational studies; 3 modelling studies)
Separating infected and non-infected residents or staff caring for them may reduce the number of infections. The measure may reduce the probability of outbreaks and may reduce the number of deaths, but the evidence for the latter is very uncertain. Isolation of cases may reduce the number of infections and the probability of outbreaks, but the evidence is very uncertain.

Multicomponent measures (2 observational studies; 1 modelling study)
A combination of multiple infection-control measures, including various combinations of the above categories, may reduce the number of infections and may reduce the number of deaths, but the evidence for the latter is very uncertain.

Authors' conclusions

This review provides a comprehensive framework and synthesis of a range of non-pharmacological measures implemented in long-term care facilities. These may prevent SARS-CoV-2 infections and their consequences. However, the certainty of evidence is predominantly low to very low, due to the limited availability of evidence and the design and quality of available studies. Therefore, true effects may be substantially different from those reported here.

Overall, more studies producing stronger evidence on the effects of non-pharmacological measures are needed, especially in low- and middle-income countries and on possible unintended consequences of these measures. Future research should explore the reasons behind the paucity of evidence to guide pandemic research priority setting in the future.

PLAIN LANGUAGE SUMMARY

Can non-medicinal measures prevent or reduce SARS-CoV-2 infections in long term care facilities?

Key messages

• Non-medicinal measures (e.g. visiting restrictions or regular testing) may prevent SARS-CoV-2 infections (causing COVID-19 disease) in residents and staff in long term care facilities, but we have concerns about the reliability of the findings.

• More high-quality studies on real-world experiences are needed, in particular.

• More research is also needed on measures in facilities where most residents and staff are vaccinated, as well as regions other than North America and Europe.

What are non-medicinal measures?

Non-medicinal measures are ways of preventing or reducing disease without using medicine, such as vaccines. These include controlling people's movements and contacts, using personal protective equipment (PPE), or regular testing for infection.

SARS-CoV-2 is very infectious. Elderly or disabled people, who live in care homes (long-term care facilities), are vulnerable to infection because they live in close contact with other people, with carers and visitors entering and leaving the facility. Due to age and underlying health conditions, care home residents have an increased risk of becoming seriously ill with COVID-19 and dying from the disease.

What did we want to find out?

We wanted to find out how effective non-medicinal measures are in preventing residents and staff in long-term care facilities from becoming infected with SARS-CoV-2 and in reducing the spread of the infection. We focused on all types of long-term care facilities for adults, such as nursing homes for the elderly and skilled nursing facilities for people living with disabilities.

What did we do?

We searched for studies that investigated the effects of non-medicinal measures in long-term care facilities. To be included, studies had to report how many infections, hospitalisations or deaths the measures prevented in residents or staff, or whether the measures prevented the introduction of the virus into the facilities or prevented outbreaks within facilities. We included any type of study, including observational studies that used ‘real-world’ data, or modelling studies based on assumed data from computer-generated simulations.

What did we find?

We found 22 studies, 11 observational and 11 modelling studies. All studies were conducted in North America or Europe.

There were four main types of measures.

1.Entry regulation measures to prevent residents, staff or visitors introducing the virus into the facility. Measures included staff confining themselves with residents, quarantine for newly-admitted residents, testing new admissions, not allowing the admission of new residents, and preventing visitors from entering facilities.

2. Contact-regulating and transmission-reducing measures to prevent people passing on the virus. Measures included wearing masks or PPE, social distancing, extra cleaning, reducing contact between residents and among staff, and placing residents and staff in care groups and limiting contact between groups.

3. Surveillance measures designed to identify an outbreak early. Measures included regular testing of residents or staff regardless of symptoms, and symptom-based testing.

4. Outbreak control measures to reduce the consequences of an outbreak. Measures included isolation of infected residents, and separating infected and non-infected residents or staff caring for them.

Some studies used a combination of these measures.

Main results

Entry regulation measures (4 observational studies; 4 modelling studies)

Most studies showed that such measures were beneficial, but some studies found no effects or unwanted effects, such as depression and delirium among residents in the context of visiting restrictions.

Contact-regulating and transmission-reducing measures (6 observational studies; 2 modelling studies)

Some measures may be beneficial, but often the evidence is very uncertain.

Surveillance measures (2 observational studies; 6 modelling studies)

Routine testing of residents and staff may reduce the number of infections, hospitalisations and deaths among residents, although the evidence on the number of deaths among staff was less clear. Testing more often, getting test results faster, and using more accurate tests were predicted to have more beneficial effects.

Outbreak control measures (4 observational studies; 3 modelling studies)

These measures may reduce the number of infections and the risk of outbreaks in facilities, but often the evidence is very uncertain.

Combination measures (2 observational studies; 1 modelling study)

A combination of different measures may be effective in reducing the number of infections and deaths.

What are the limitations of the evidence?

Our confidence in these results is limited. Many studies used mathematical prediction rather than real-world data, and we cannot be confident that the model assumptions are accurate. Most observational studies did not use the most reliable methods. This means we cannot be confident that the measure caused the effect, for example, that testing of residents reduced the number of deaths.

How up to date is this evidence?

This review includes studies published up to 22 January 2021.

SUMMARY OF FINDINGS

Summary of findings 1. Entry regulation measures

Outcomes	Number and type of studies (Overall number of facilities)	Impact	Certainty of evidence	Summary of findings
Intervention category 1. Self-confinement of staff with residents				
Number of infections	1 observational study (LTCFs: 17 IG/9513 CG)	The study showed clear effects favouring the measure in 2 assessments. Higher levels of adherence to and introduction of the measure prior to detection of the first case were associated with more pronounced effects favouring the measure.	Low[a] ⊕⊕◯◯	The measure may reduce the number of infections.
Probability of contamination of facilities	1 observational study (LTCFs: 17 IG/9513 CG)	The study showed a clear effect favouring the measure. Introduction of the measure prior to detection of the first case was associated with more pronounced effects favouring the measure.	Low[a] ⊕⊕◯◯	The measure may reduce the probability of contamination of facilities.
Number of deaths	1 observational study (LTCFs: 17 IG/9513 CG)	The study showed a clear effect favouring the measure. Higher levels of adherence to and introduction of the measure prior to detection of the first case were associated with more pronounced effects favouring the measure.	Low[a] ⊕⊕◯◯	The measure may reduce the number of deaths.
Intervention category 2. Quarantine for new admissions				
Number of infections	1 observational study (LTCFs: 24)	The study showed an unclear effect favouring the measure.	Very low[b,c,d] ⊕◯◯◯	The measure may reduce the number of infections, but the evidence is very uncertain.
Number of infections	1 modelling study	The study predicted a clear effect favouring the measure.	Low[e,f] ⊕⊕◯◯	The measure may reduce the number of infections.
Intervention category 3. Testing of new admissions				
Number of infections	1 modelling study	The study predicted an unclear effect favouring the measure in 2 assessments.	Very low[e,f,g] ⊕◯◯◯	The measure may reduce the number of infections, but the evidence is very uncertain.
Intervention category 4. Intensified testing of re-admissions of residents and staff after holidays				
Number of infections	1 modelling study	The study predicted an unclear effect favouring the measure. It model-predicted effects favouring higher rates of testing, and testing of residents and staff compared with testing only residents or staff.	Very low[f,g,h] ⊕◯◯◯	The measure may reduce the number of infections, but the evidence is very uncertain.
Intervention category 5. Restricting the admission of new residents				

Number of infections	1 observational study (LTCFs: 3129)	The study showed a clear effect favouring the measure regarding the number of infections among residents, and null effects regarding the number of infections among staff and outbreak size.	Very low[a,d,i] ⊕◯◯◯	The evidence is very uncertain about the measure reducing the number of infections.
Probability of contamination of facilities	1 observational study (LTCFs: 3129)	The study showed a clear effect favouring the measure.	Low[a] ⊕⊕◯◯	The measure may reduce the probability of contamination of facilities.
Intervention category 6. Admission restrictions for visitors				
Number of infections	1 observational study (LTCFs: 3129)	The study showed unclear effects favouring the measure in 3 assessments.	Very low[a,d] ⊕◯◯◯	The measure may reduce the number of infections, but the evidence is very uncertain.
Probability of contamination of facilities	1 observational study (LTCFs: 3129)	The study showed an unclear effect favouring the control.	Very low[a,d] ⊕◯◯◯	The measure may increase the probability of contamination of facilities, but the evidence is very uncertain.
Number of deaths	1 modelling study	The study predicted a clear effect favouring the measure.	Low[e,f] ⊕⊕◯◯	The measure may reduce the number of deaths.
Adverse effects	1 observational study (LTCFs: 7)	The study showed an unclear effect favouring the measure regarding rates of depression and behavioural problems among all residents, as well as regarding delirium among individuals with Alzheimer's disease and other dementias. The study showed an unclear effect favouring the control regarding delirium among individuals without Alzheimer's disease and other dementias.	Very low[a,d,i] ⊕◯◯◯	The evidence is very uncertain about the measure increasing or decreasing the adverse mental health effects among residents.

CG: control group; **IG:** intervention group; **LTCFs:** long-term care facilities

[a]Downgraded by 2 for risk of bias: inadequate adjustment for confounders in observational studies assessed with ROBINS-I.
[b]Downgraded by 2 for study design: non-experimental observational study with the risk of bias not assessed with ROBINS-I.
[c]Downgraded by 1 for inadequate adjustment for confounders and risk of misclassification of the intervention in observational studies not assessed with ROBINS-I.
[d]Downgraded by 1 for imprecision of the direction of effect: confidence intervals of observational studies include beneficial, null, or harmful effects.
[e]Downgraded by 1 for risk of bias: moderate concerns regarding parameter or structural assumptions of the model.
[f]Downgraded by 1 for indirectness: lack of external validation of the model.
[g]Downgraded by 1 for imprecision of the direction of effect: insufficient assessment of uncertainty in the model or large confidence intervals allowing the possibility of a null effect or effect in the opposite direction in modelling studies.
[h]Downgraded by 2 for risk of bias: serious concerns regarding parameter or structural assumptions of the model.
[i]Downgraded by 1 for inconsistency in the direction of effect.

Summary of findings 2. Contact -regulating and transmission -reducing measures

Outcomes	Number and type of studies	Impact	Certainty of evidence	Summary of findings

	(Overall number of LTCFs)			
Intervention category 1. Barrier nursing				
Number of infections	1 observational study (LTCFs: 3129)	The study showed clear effects favouring the control regarding the number of infections among residents and among staff, and an unclear effect favouring the control regarding outbreak size. The study showed an effect favouring barrier nursing for all residents compared with barrier nursing for infected residents only.	Very low[a] ⊕◯◯◯	The measure may increase the number of infections, but the evidence is very uncertain.
Probability of outbreaks	1 observational study (LTCFs: 3129)	The study showed a clear effect favouring the control. The study showed an effect favouring barrier nursing for all residents compared with barrier nursing for infected residents only.	Very low[a] ⊕◯◯◯	The measure may increase the probability of outbreaks, but the evidence is very uncertain.
Intervention category 2. Cleaning and environmental hygiene measures				
Number of infections	1 observational study (LTCFs: 24)	The study showed an unclear effect favouring the measure.	Very low[b,c,d] ⊕◯◯◯	The measure may reduce the number of infections, but the evidence is very uncertain.
Intervention category 3. Higher frequency of cleaning				
Number of infections	2 observational studies (LTCFs: 24; 3048, 3014; and 2848)	The studies assessed 4 measures in 10 assessments: 1 assessment showed a clear effect favouring the measure, 3 assessments showed an unclear effect favouring the measure, 1 assessment showed a null effect, 3 assessments showed an unclear effect favouring the control, and 2 assessments showed a clear effect favouring the control.	Very low[b,c,d,e] ⊕◯◯◯	The evidence is very uncertain about the measure increasing or decreasing the number of infections.
Probability of outbreaks	1 observational study (LTCFs: 3048, 3014; and 2848)	The study showed unclear effects favouring the measures in 1 assessment and unclear effects favouring the control in 2 assessments.	Very low[a,d,e] ⊕◯◯◯	The evidence is very uncertain about the measure increasing or decreasing the probability of outbreaks.
Intervention category 4. Contact reduction measures				
Number of infections	1 observational study (LTCFs: 24)	On resident-focused contact-reduction measures, the study showed an unclear effect favouring the measure. On staff-focused contact-reduction measures, the study showed an unclear effect favouring the measure in 1 assessment and a clear effect favouring the measure in another assessment.	Very low[b,c,d] ⊕◯◯◯	The measure may reduce the number of infections, but the evidence is very uncertain.
Probability of outbreaks	2 observational studies (LTCFs: 34 and 124)	Two studies assessed 4 measures: 1 study showed unclear effects favouring the measures in 2 assessments and both studies	Very low[b,c,d,e] ⊕◯◯◯	The evidence is very uncertain about the measure increasing or de-

		showed unclear effects favouring the control in 1 assessment, respectively. Confinement of residents in rooms showed unclear effects favouring the control in both studies. Contact reduction measures during meals and during group activities showed unclear effects favouring the measure.		creasing the probability of outbreaks.
Intervention category 5. Personal hygiene measures				
Probability of outbreaks	1 observational study (LTCFs: 124)	The study showed unclear effects favouring the measures in 2 assessments.	Very low[b,c,d] ⊕◯◯◯	The measure may reduce the probability of outbreaks, but the evidence is very uncertain.
Intervention category 6. Mask and PPE use				
Number of infections	3 observational studies (LTCFs: 12; 24; and 360)	3 studies assessed 8 measures regarding the use of masks and PPE: 3 studies showed clear effects favouring the measures in 4 assessments and 1 study showed unclear effects favouring the measure in 1 assessment. Regarding training on mask use: 1 study showed unclear effects favouring the measure in 2 assessments and a clear effect favouring the measures in 1 assessment.	Very low[b,c] ⊕◯◯◯	The measure may reduce the number of infections, but the evidence is very uncertain.
Probability of outbreaks	1 observational study (LTCFs: 124)	1 study showed an unclear effect favouring the control.	Very low[b,c,d] ⊕◯◯◯	The measure may increase the probability of outbreaks, but the evidence is very uncertain.
Number of deaths	1 observational study (LTCFs: 360)	The study showed a clear effect and an unclear effect favouring the measure in 1 assessment.	Very low[d,f] ⊕◯◯◯	The measure may reduce the number of deaths, but the evidence is very uncertain.
Intervention category 7. Cohorting residents and staff				
Number of infections	1 modelling study	The study predicted an unclear effect favouring the measure of immunity-based cohorting of residents (i.e. assigning residents who are immune with residents who are susceptible to SARS-CoV-2 infections) in 2 assessments.	Very low[g,h,i] ⊕◯◯◯	The measure may reduce the number of infections, but the evidence is very uncertain.
Probability of outbreaks	1 observational study (LTCFs: 124)	The study showed a clear effect favouring the cohorting of residents and an unclear effect favouring the control regarding the cohorting of staff.	Very low[b,c,d,e] ⊕◯◯◯	Evidence is very uncertain about the measure increasing or decreasing the probability of outbreaks.
Intervention category 8. Multicomponent contact and transmission control measures				
Probability of outbreaks	1 observational study (LTCFs: 124)	The study showed a clear effect favouring the measure.	Very low[b,c] ⊕◯◯◯	The measure may reduce the probability of

	outbreaks, but the evidence is very uncertain.

LTCFs: long-term care facilities

[a]Downgraded by 3 for risk of bias: inadequate adjustment for confounders and risk of misclassification of the intervention in observational studies assessed with ROBINS-I.
[b]Downgraded by 2 for study design: non-experimental observational study with the risk of bias not assessed with ROBINS-I.
[c]Downgraded by 1 for risk of bias: inadequate adjustment for confounders and risk of misclassification of the intervention in observational studies not assessed with ROBINS-I.
[d]Downgraded by 1 for imprecision of the direction of effect: confidence intervals of most observational studies include beneficial, null, or harmful effects.
[e]Downgraded by 1 for inconsistency in the direction of effect.
[f]Downgraded by 2 for risk of bias: inadequate adjustment for confounders and assessment of outcomes in observational studies assessed with ROBINS-I.
[g]Downgraded by 1 for risk of bias: moderate concerns regarding parameter or structural assumptions of the model.
[h]Downgraded by 1 for indirectness: lack of external validation of the model.
[i]Downgraded by 1 for imprecision of the direction of effect: insufficient assessment of uncertainty in the model or large confidence intervals allowing the possibility of a null effect or effect in the opposite direction.

Summary of findings 3. Surveillance measures

Outcomes	Number of studies (Overall number of LTCFs)	Impact	Certainty of evidence	Summary of findings
Intervention category 1. Routine testing of residents and staff independent of symptom status				
Number of infections	1 observational study (LTCFs: 28)	The study showed clear effects favouring the measure regarding the number of infections in 2 assessments.	Low[a] ⊕⊕◯◯	The measure may reduce the number of infections.
Number of infections	4 modelling studies	3 studies predicted a clear effect and 1 study an unclear effect favouring the measure. The effects were predicted to be stronger in scenarios with more stringent measures. The studies predicted effects favouring higher rates of testing, testing higher proportions of the populations at the same rate of testing, antigen-based testing in comparison with PCR-based testing at the same rate of testing, shorter turnaround times, and higher test sensitivity. Furthermore, they predicted effects favouring the testing of residents and staff over testing residents only and over testing staff members only.	Low[b,c,d] ⊕⊕◯◯	The measure may reduce the number of infections.
Probability of outbreaks	1 modelling study	The study predicted an unclear effect favouring the measure. The effects were predicted to be stronger in scenarios with more stringent measures. The study predicted effects favouring testing higher proportions of the populations at the same rate of testing.	Very low[b,c,e] ⊕◯◯◯	The measure may reduce the probability of outbreaks, but the evidence is very uncertain.

Number of hospitalisations	1 observational study (LTCFs: 28)	The study showed clear effects favouring the measure in 2 assessments.	Low[a] ⨁⨁◯◯	The measure may reduce the number of hospitalisations.
Number of hospitalisations	1 modelling study	The study predicted clear effects favouring the measure in 2 assessments. The effects were predicted to be stronger in scenarios with more stringent measures. The study predicted effects favouring shorter turnaround times and higher test sensitivity.	Moderate[c] ⨁⨁⨁◯	The measure probably reduces the number of hospitalisations.
Number of deaths	1 observational study (LTCFs: 28)	The study showed a clear effect favouring the measure regarding the number of deaths among residents and a clear effect favouring the control regarding the number of deaths among staff.	Very low[a,f] ⨁◯◯◯	The evidence is very uncertain about the measure increasing or decreasing the number of deaths.
Number of deaths	1 modelling study	The study predicted clear effects favouring the measure regarding the number of deaths among residents and unclear effects favouring the measure regarding the number of deaths among staff. The effects were predicted as stronger in scenarios with more stringent measures. The study predicted effects favouring shorter turnaround times and higher test sensitivity.	Low[c,e] ⨁⨁◯◯	The measure may reduce the number of deaths.
Intervention category 2. Symptom-based surveillance testing				
Number of infections	1 observational study (LTCFs: 24)	The study showed an unclear effect favouring the measure.	Very low[g,h,i] ⨁◯◯◯	The measure may reduce the number of infections, but the evidence is very uncertain.
Number of infections	1 modelling study	The study predicted an unclear effect favouring the measure.	Very low[b,c,e] ⨁◯◯◯	The measure may reduce the number of infections, but the evidence is very uncertain.
Probability of outbreaks	1 modelling study	The study predicted an unclear effect favouring the measure.	Very low[b,c,e] ⨁◯◯◯	The measure may reduce the probability of outbreaks, but the evidence is very uncertain.

LTCFs: long-term care facilities

[a]Downgraded by 2 for risk of bias: inadequate adjustment for confounders in observational studies assessed with ROBINS-I.
[b]Downgraded by 1 for risk of bias: moderate concerns regarding parameter and structural assumptions of the models in all or most studies.
[c]Downgraded by 1 for indirectness: lack of external validation of the models in all or most studies.
[d]Not downgraded for imprecision of the direction of effect: assessment of uncertainty was rated as sufficient and confidence intervals did not include for the possibility of a null or adverse effect in most studies.
[e]Downgraded by 1 for imprecision of the direction of effect: insufficient assessment of uncertainty in the model or large confidence intervals allowing the possibility of a null effect or effect in the opposite direction in modelling studies.
[f]Downgraded by 1 for inconsistency in the direction of effects.

[g]Downgraded by 2 for study design: non-experimental observational study with the risk of bias not assessed with ROBINS-I.
[h]Downgraded by 1 for inadequate adjustment for confounders and risk of misclassification of the intervention in observational studies not assessed with ROBINS-I.
[i]Downgraded by 1 for imprecision of the direction of effect: confidence intervals of observational studies include beneficial, null, or harmful effects.

Summary of findings 4. Outbreak control measures

Outcomes	Number of studies	Impact	Certainty of evidence	Summary of findings
Intervention category 1. Separation of infected and non-infected residents or staff caring for infected and non-infected residents				
Number of infections	3 observational studies (LTCFs: 24, 360, and 1521)	1 study showed a clear effect favouring the measure in 2 assessments, 1 study showed a clear effect favouring the measure in 1 and an unclear effect favouring the measure in 2 assessments. 1 study showed a clear effect favouring the measure in 2 assessments and an unclear effect favouring the control in 1 assessment.	Very low[a,b,c] ⊕◯◯◯	The measure may reduce the number of infections, but the evidence is very uncertain.
Number of infections	1 modelling study	The study predicted unclear effects in 2 assessments favouring the measure of immunity-based staffing (i.e. assigning staff members who are immune to SARS-CoV-2 infections to the non-COVID-19 units and vice versa).	Very low[d,e,f] ⊕◯◯◯	The measure may reduce the number of infections, but the evidence is very uncertain.
Probability of outbreaks	1 observational study (LTCFs: 1050)	The study showed a clear effect favouring the measure.	Low[g] ⊕⊕◯◯	The measure may reduce the probability of outbreaks.
Number of deaths	1 observational study (LTCFs: 360)	The study showed unclear effects favouring the measure in 2 assessments.	Very low[g,h] ⊕◯◯◯	The measure may reduce the number of deaths, but the evidence is very uncertain.
Intervention category 2. Isolation of cases				
Number of infections	1 observational study (LTCFs: 3129)	The study showed clear effects favouring the measure in 3 assessments.	Very low[g,i] ⊕◯◯◯	The measure may reduce the number of infections, but the evidence is very uncertain.
Probability of outbreaks	2 observational studies (LTCFs: 1356 and 1881)	The studies showed a clear effect favouring the measure.	Very low[g,i] ⊕◯◯◯	The measure may reduce the probability of outbreaks, but the evidence is very uncertain.

[a]Not downgraded for imprecision of the direction of effect, as in most assessments and in most studies, the confidence intervals did not include for the possibility of a null or adverse effect.
[b]Downgraded by 2 for study design: non-experimental observational study with the risk of bias not assessed with ROBINS-I.
[c]Downgraded by 1 for inconsistency in the direction of effect.
[d]Downgraded by 1 for risk of bias: moderate concerns regarding parameter and structural assumptions of the model.
[e]Downgraded by 1 for indirectness: lack of external validation of the model.

[f]Downgraded by 1 for imprecision of the direction of effect: insufficient assessment of uncertainty in the model or large confidence intervals allowing the possibility of a null effect.
[g]Downgraded by 2 for risk of bias: inadequate adjustment for confounders and assessment of outcomes in observational studies assessed with ROBINS-I.
[h]Downgraded by 1 for imprecision of the direction of effect: confidence intervals of observational studies include beneficial, null, or harmful effects.
[i]Downgraded by 1 for indirectness: assessment based on surrogate indicator of "problems with isolating cases" to assess the effect of the measure.

Summary of findings 5. Multicomponent measures across multiple intervention domains

Outcomes	Number of studies (Overall number of LTCFs)	Impact	Certainty of evidence	Summary of findings
Intervention category. Multicomponent measures, including entry regulation, transmission and contact control, surveillance, and outbreak control measures				
Number of infections	2 observational studies (LTCFs: 18 and 360)	The studies showed a clear effect favouring the measure in 4 assessments.	Low[a] ⨁⨁◯◯	The measure may reduce the number of infections.
Number of infections	1 modelling study	The study predicted a clear effect favouring the measure.	Low[b,c] ⨁⨁◯◯	The measure may reduce the number of infections.
Number of deaths	1 observational study (LTCFs: 360)	The study showed clear effects favouring the measure in 2 assessments.	Very low[d,e] ⨁◯◯◯	The measure may reduce the number of deaths, but the evidence is very uncertain.

LTCFs: long-term care facilities

[a]Downgraded by 2 for risk of bias: inadequate adjustment for confounders.
[b]Downgraded by 1 for risk of bias: moderate concerns regarding parameter and structural assumptions of the model.
[c]Downgraded by 1 for indirectness: lack of external validation of the model.
[d] Downgraded by 2 for risk of bias: inadequate adjustment for confounders and assessment of outcomes.
[e]Downgraded by 1 for imprecision of the direction of effect: confidence intervals include the possibility of beneficial, null, or harmful effects.

BACKGROUND

Description of the condition

The novel coronavirus disease strain, coronavirus disease 2019 (COVID-19), is caused by the highly-transmittable severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) (Zhou 2020). It first emerged in Wuhan, China in 2019 and rapidly spread worldwide, being declared a global health emergency by the World Health Organization (WHO) on 30 January 2020 (WHO 2020a). The consequences of an infection with SARS-CoV-2 can range from no or mild symptoms of an upper respiratory tract infection to acute respiratory distress syndrome and death (Hu 2021).

The global pandemic has affected different population groups unevenly. Early in the pandemic, studies reported on the influence of age on COVID-19-related morbidity and mortality. Senior citizens, and in particular (but not limited to) those with pre-existing conditions, such as Alzheimer's disease and other dementias, face the highest risk (Manca 2020; Mok 2020). While there is a low risk of death (less than 0.01%) in infected individuals aged younger than 50 years, this risk sharply increases in older age groups, with an estimated infection fatality rate of 12% to 16% in infected men and 5% to 6% in infected women 80 years and older (Bonanad 2020; Pastor-Barriuso 2020; Williamson 2020). Another group with a higher risk of severe outcomes from COVID-19 is people living with intellectual and developmental disabilities (IDD), such as people with Down's syndrome (Clift 2021; Turk 2020). An important factor in the transmission dynamics of SARS-CoV-2 is the so called 'superspreading event', where one infected individual causes a very large number of secondary cases, often in a specific setting. Outbreaks linked to superspreading events have been found to be associated with enclosed, poorly-ventilated indoor environments, where adherence to protective measures such as social distancing is difficult or impossible, hence leading to high human contact rates with elevated risk of transmission over prolonged periods of time (Althouse 2020; Koh 2020; Wong 2020). Long-term care facilities display all these features and have therefore been found to be at high risk for outbreaks and superspreading events (Comas-Herrera 2020; ECDC 2020; Koh 2020; Salcher-Konrad 2020). For example, during the first three weeks of January 2021, the Robert Koch Institute (Germany's National Public Health Institute) classified 50,839 COVID-19 cases as being attributed to outbreaks in high-risk settings. Of those, 22,568 (44%) were attributed to long-term care facilities, a setting in which less than 1% of the German population resides (RKI 2021).

The combination of a setting characterised by features that increase the risk for SARS-CoV-2 transmission and inhabitants at high risk of suffering a severe course of COVID-19, due to their age and health status, has made long-term care facilities a focal point for the morbidity and mortality burden of the SARS-CoV-2 pandemic. According to the European Centre for Disease Prevention and Control (ECDC), between 26% (England and Wales) and 66% (Spain) of all deaths during the first wave of the COVID-19 pandemic in 11 European countries were among residents of long-term care facilities (ECDC 2020). While less than 1% of the US population lives in long-term care facilities, this population accounted for 36% of the country's COVID-19 deaths (The COVID Tracking Project 2021). The International Long-Term Care Policy Network, which tracks the COVID-19-related mortality burden in long-term care facilities, found that, on average, 46% of deaths in 21 high- and middle-income countries were attributable to long-term care facilities (Comas-Herrera 2020). According to their report, 4% of care home residents in Belgium, Ireland, Spain, the UK, and the USA had died as a result of COVID-19 by October 2020.

Description of the interventions

To protect residents and staff in long-term care facilities from COVID-19, various protective measures have been recommended in several national and international guidelines (Rios 2020; WHO 2020b; WHO 2020b; WHO WPRO 2020). These have been implemented to a varying extent (Fischer 2020; Frazer 2020a; Gmehlin 2020; WHO 2020b). Based on a preliminary scoping of the literature, we developed an a priori process-based logic model to display the relationships between intervention domains and outcomes (Figure 1), and a system-based logic model to describe and classify relevant interventions in relation to broader contextual factors (Figure 2). These models represent the authors' evidence-informed understanding of the system in which the measures to protect residents of long-term care facilities were implemented during the present SARS-CoV-2 pandemic. Based on this, we have distinguished four domains of measures that focus on:

Figure 1. Figure 1: Process-based logic model on the relation between intervention domains and outcomes (LTCF: long-term care facility)

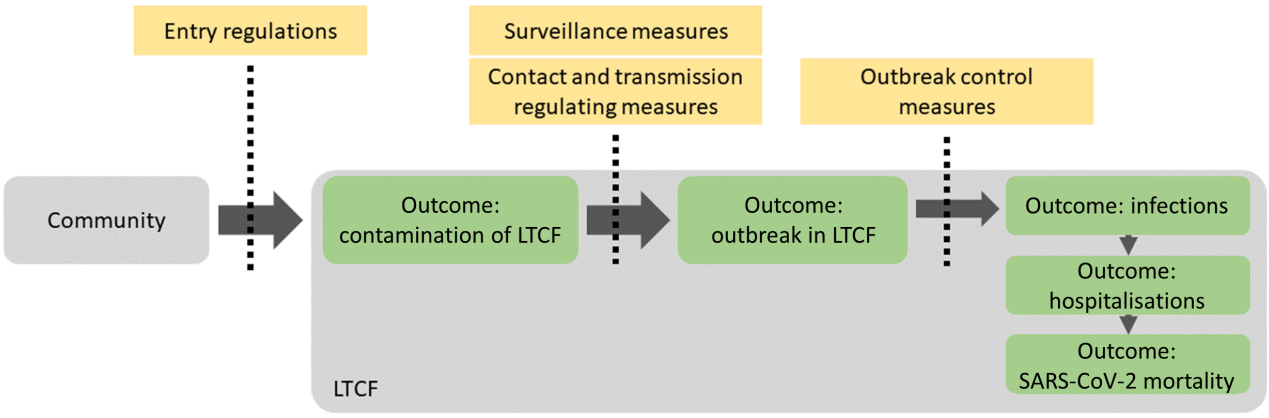
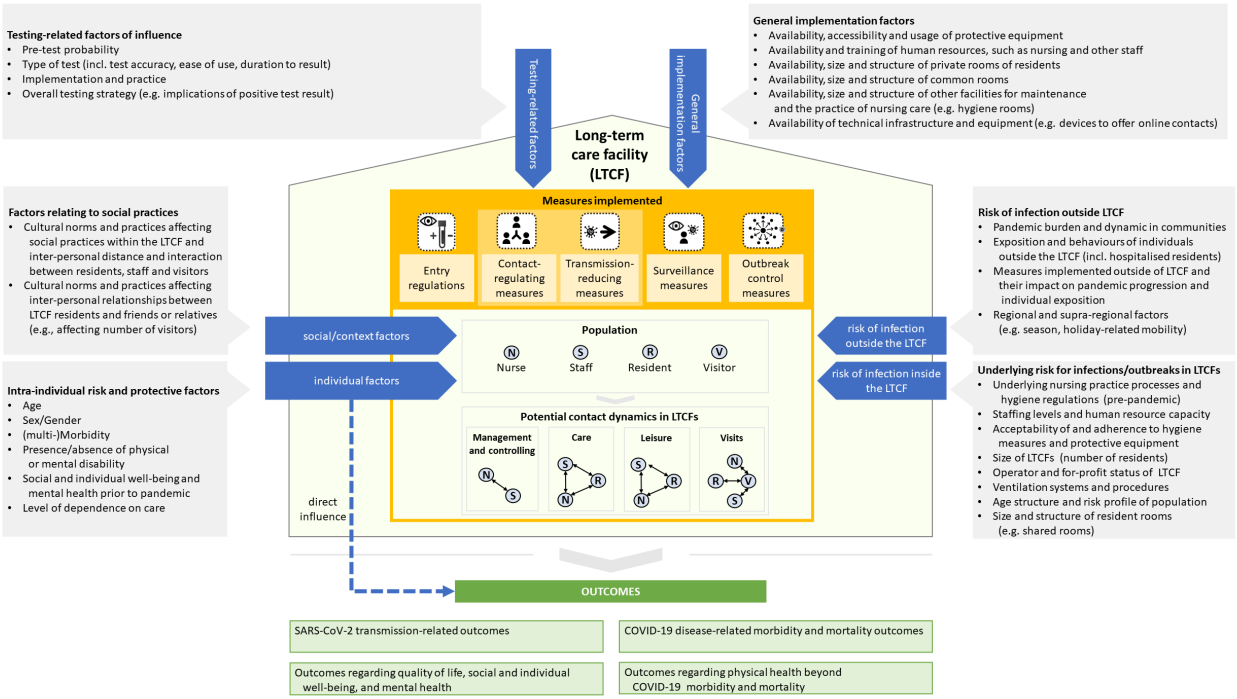


Figure 2. Figure 2: System-based logic model of the interventions and contextual factors as potential moderators (LTCF: long-term care facility; Mgmt: management)



1. entry regulations;
2. regulating contacts and reducing transmission;
3. surveillance; and
4. outbreak control measures.

Entry regulations

Entry regulation measures are designed to prevent infected individuals from entering long-term care facilities, potentially reducing the risk of infection for residents and staff. This can be achieved, for example, through rapid antigen testing of visitors and staff prior to entry, recommendations or regulations on abstaining from visiting or working in the presence of symptoms of a respiratory tract infection, or policies temporarily suspending visits from friends and relatives (Frazer 2020a; Gmehlin 2020; Rios 2020).

Contact-regulating measures

Some interventions work by altering daily routines and practices within the facility. Contact-regulating measures aim to reduce the risk of infection through reducing the number of contacts with potential for transmission or the risk of transmission upon contact occurring. Contact-regulating measuresto reduce the number of contacts with potential for transmission include: physical distancing; moving residents from shared rooms into single rooms; limiting the number of people present in common rooms at any point in time, such as through staggered dining times; suspending non-essential services (e.g. hairdressing services for residents); suspending group activities (such as gathering in large groups for religious services); or cohorting wards (Frazer 2020a; Gmehlin 2020; Rios 2020).

Transmission-reducing measures

Transmission-reducing measures can be implemented to reduce the risk of transmission (from droplets or airborne particles) upon contact occurring. These include: guidelines on respiratory hygiene and cough etiquette; physical barriers, such as mobile acrylic glass walls; or regulations on mask wearing (e.g. requiring staff to wear masks when interacting with residents). Measures may also include suspending activities that are judged to be at high risk of producing aerosols, such as singing (Rios 2020). Other measures aim to reduce the risk of infection stemming from the physical environment. These include measures to reduce fomite transmission, for example, by limiting the use of shared equipment, adapting surface-cleaning measures, or usage of protective equipment such as gloves (Frazer 2020a; Gmehlin 2020; Rios 2020). Other transmission-reducing measures aim to reduce the number of infectious particles in the air through active or passive ventilation or air filtration technologies (Kohanski 2020).

Surveillance measures

Surveillance measures, such as surveillance testing (e.g. weekly antigen testing) or symptom-based screening (e.g. daily temperature measurement) conducted in a sample of residents on a regular basis, where there is no known case in the facility or among staff members, are implemented to facilitate early detection. Such strategies may prevent secondary infections or outbreaks within facilities, if appropriate measures are taken when positive cases are identified. This is of particular importance due to the risk of SARS-CoV-2 transmission by asymptomatic or pre-symptomatic individuals (Salcher-Konrad 2020).

Outbreak-control measures

Interventions can also focus on preventing secondary infections or outbreaks within long-term care facilities in the event that a SARS-CoV-2 infection is detected within the facility or a high risk of infection is suspected among residents, staff or visitors. This can include outbreak control measures, such as isolation of infected individuals or quarantine following a potential exposure (e.g. after contact with a visitor who tested positive for SARS-CoV-2 or upon returning from medical treatment outside the facility). It can also entail mass testing strategies, or increasing the strictness of contact-regulating or transmission-reducing measures in comparison to those implemented before the infection was detected (Hatfield 2020; Shrader 2020).

How the interventions might work

As displayed in Figure 1, entry regulations aim to prevent the introduction of infectious agents from the community into the facility (via staff, residents or visitors) and thereby prevent contamination, defined as at least one individual infected with SARS-CoV-2 in the facility. Contact-regulating and transmission-reducing measures aim to prevent the transmission of SARS-CoV-2 from unknown or as yet un identified cases, such as pre-symptomatic staff members to individuals within the facility who are not yet infected. Surveillance measures aim to detect infections at an early stage and prevent further transmission through targeted measures, such as isolation. Measures in both intervention domains can stop or prevent progression of a (known or unknown) contamination in a facility into an outbreak, defined as secondary infection. Furthermore, these measures, as well as other outbreak control measures, can contribute to limiting the number of infections, and, as a result, the number of hospitalisations and SARS-CoV-2-related deaths. The effectiveness of these measures is likely to vary, depending on implementation factors influencing fidelity to an intervention's key functions, as well as consistency of delivery and maintenance over time (Hawe 2004). For example, a national directive on the wearing of FFP2-masks by nursing staff in their interaction with residents may not be consistently implemented due to a lack of protective equipment (Nyashanu 2020). Similarly, the screening of visitors to the nursing home using rapid antigen tests may miss a higher proportion of cases due to inappropriate approaches to taking swab samples (Lippi 2020), or staff shortages (Nyashanu 2020). Adherence to measures may be influenced by their general comprehensibility and acceptability, as well as by the approach taken to enforcing them. Adherence levels can have profound implications on the effectiveness of such measures (Nyashanu 2020).

The effectiveness of these measures on SARS-CoV-2 transmission may be moderated by contextual factors within and outside of the facilities. Characteristics of long-term care facilities that have been linked to infections or outbreaks within facilities include for-profit status of the facility (Shallcross 2020), lower staff-to-resident ratios (Shallcross 2020), larger facility size in terms of beds or staff (Temkin-Greener 2020), quality ratings of the facility (Bui 2020), presence of healthcare unions (Dean 2020), reliance on agency staff (Shallcross 2020), higher occupancy rates (Shen 2020), and the sharing of rooms by residents (Frazer 2020a). While some of these factors may be causally linked to an increased risk of infection (e.g. sharing a room leads to a higher probability of transmission), others could merely be associated with other causally linked risk factors (e.g. if a facility with lower quality ratings has a higher rate of shared rooms).

Moderating factors outside care facilities could include broader sociocultural norms and practices, for example, the frequency of visits of the relatives and how they interact with the residents. Furthermore, risk factors for infection outside the facilities are likely to be of relevance; a high disease burden within a community could lead to a higher probability of staff and visitors being infected with SARS-CoV-2 and carrying the infection into the facility. Factors such as staff living in high-prevalence communities or high levels of transmission in the community where the facility is located have been found to be associated with increased SARS-CoV-2 infections and COVID-19-related mortality in the facility (Bui 2020; Gorges 2020; Lipsitz 2020; Shen 2020; Shi 2020; Sugg 2021; Temkin-Greener 2020). Other factors at the country level that were found to be associated with infections or outbreaks include per-capita income, unemployment rate, level of urbanisation, and population density (Sugg 2021). It is possible that these factors influence local levels of community transmission or are associated with characteristics of care facilities, which could increase the risk of outbreaks. Contextual factors such as these could explain the difference in effectiveness of the same measure across different long-term care facilities, and should be accounted for in research on COVID-19 in these settings.

The intended effect of these measures is to prevent or reduce the transmission of SARS-CoV-2 and related morbidity and mortality. However, some of these measures are highly intrusive, for example the restriction of interactions of residents with other residents or with their family and friends. Numerous researchers and advocacy groups have pointed out the adverse effects of such non-pharmacological measures on the mental and physical health of long-term care facility residents, such as reduced physical activity, loneliness and social isolation, reduced well-being, and risk of depression and anxiety (Abbasi 2020; D'Cruz 2020; El Haj 2020b; Lekamwasam 2020), and staff, for example, psychological distress or burn-out (El Haj 2020a; Senczyszyn 2020). Furthermore, ethicists have criticised proposed interventions in long-term care facilities for being potentially ageist, undermining individual autonomy, and infringing on basic human rights (Blanco-Donoso 2021; D'Cruz 2020; Lekamwasam 2020). Adverse effects of protective measures have been particularly reported and discussed regarding people living with dementia (Manca 2020).

Intended and unintended effects of these measures are likely to depend on individual-level risk and protective factors, and do not solely depend on the measure implemented. These factors could affect the probability of adverse outcomes directly, for example as men over 80 years old are more likely to die from a SARS-CoV-2 infection (Pastor-Barriuso 2020). However, they could also affect the risk of infection through behaviours or interactions. For example, adhering to social distancing might be more challenging for people living with dementia (Nyashanu 2020). Such individual-level factors associated with elevated mortality rates following an outbreak in a long-term care facility have been found to be linked to older age, male sex, frailty, dependency on care, and dementia among residents (Dutey-Magni 2020; Heras 2020; Shi 2020; Temkin-Greener 2020). Furthermore, the particular challenges of individuals living with cognitive impairment regarding understanding of and adherence to infection control practices have been discussed as relevant factors in the

effectiveness of infection control measures (Brown 2020; Manca 2020; Mok 2020).

Why it is important to do this review

A large proportion of the morbidity and mortality burden of the ongoing pandemic is attributable to cases of illness and death among residents and staff in long-term care facilities (Comas-Herrera 2020). The implementation of effective measures to prevent or reduce the number of infections in these facilities could therefore considerably reduce the overall burden due to COVID-19. High-quality reviews of the scientific literature can support decision-makers in identifying and implementing appropriate measures to protect vulnerable populations in long-term care facilities during the SARS-CoV-2 pandemic, whilst avoiding or mitigating the potential for severe adverse effects associated with these interventions.

Several publications have provided literature reviews of low to moderate quality on measures implemented in long-term care facilities to protect residents from COVID-19 (Fischer 2020; Frazer 2020a; Gmehlin 2020; WHO 2020b), on the unintended effects of these measures (D'Cruz 2020; Lekamwasam 2020), and on recommendations and guidelines for nursing care during the SARS-CoV-2 pandemic (Bolt 2020; Rios 2020). Two reviews that aimed to assess the effectiveness of non-pharmacological measures implemented in long-term care facilities were published in August 2020 and July 2020, respectively: a scoping review by Fischer 2020, and a pilot of a systematic review conducted to inform a policy brief by WHO (WHO 2020a). With the rapid progression of research on the topic in 2020, their searches are very likely outdated. Reviews by Salcher-Konrad 2020 and Gmehlin 2020 focused on SARS-CoV-2 transmission, COVID-19-related mortality, and clinical presentation of the disease in long-term care facilities, without assessing the effectiveness of protective measures. Frazer 2020b and NCCMT 2020 conducted systematic literature reviews on measures to protect older people in long-term care facilities from COVID-19, which included studies published up to 27 July 2020 and 30 November 2020 respectively. However, while these reviews summarised the identified publications, the authors did not conduct a synthesis that allowed estimates of the effectiveness of protective measures to be inferred, and neither study systematically included modelling studies in their analysis. The literature reviews by Lekamwasam 2020 and D'Cruz 2020 assessed the effects of the COVID-19 pandemic on the health and well-being of older people. However, they did not comprehensively assess the implications of non-pharmacological measures implemented in long-term care facilities.

Despite the importance of the topic, to the best of our knowledge no high-quality systematic review on this topic has yet been conducted.

OBJECTIVES

To assess the effects of non-pharmacological measures implemented in long-term care facilities to prevent or reduce the transmission of SARS-CoV-2 infection among residents, staff and visitors.

METHODS

For this rapid review, we employed procedures in accordance with the Cochrane guidance for rapid reviews (Garritty 2020; Garritty 2021). The methods were prespecified in a protocol that was reviewed and approved by Cochrane Public Health (New Reference). To make it feasible for the review to be conducted rapidly, we limited its scope (e.g. we considered only a specific set of non-pharmacological measures), omitted some quality control procedures (e.g. limiting the exploration of heterogeneity of included studies), and simplified the process of data extraction (i.e. one review author conducted the data extraction, and a second review author checked for correctness). To ensure that the acceleration of the review process did not compromise the methodological rigor of the review, we piloted procedures for each review stage, conducted regular team meetings, and kept a rolling list of questions to address uncertainties as they arose. We used an a priori developed logic model for considering studies for this review (see Figure 1 and Figure 2).

Criteria for considering studies for this review

We included studies that quantitatively assessed the impact of measures implemented in the setting of long-term care facilities to prevent or reduce SARS-CoV-2 transmission and COVID-19-related outcomes. The full list of eligibility criteria is described in Appendix 1.

Types of studies

We included two groups of studies: firstly, randomised trials (RCTs) and non-randomised observational studies of intervention effects; and secondly, mathematical modelling studies.

Experimental and observational studies of intervention effects

Due to the rapid progress of the pandemic and the challenges associated with the evaluation of complex public health interventions, it is not always appropriate, feasible or ethical to conduct RCTs. We therefore did not expect to identify a great number of RCTs at the time this review was conducted. Within the first group, we included studies that fulfilled the following two criteria:

1. The study was based on systematically collected, quantitative data on one of the outcomes of interest, with at least one point of data collection after the intervention;
2. The study allowed the effect of the intervention to be estimated, either:
   a. Based on an estimated change over time (either through the same or different individuals at multiple time points before and after the intervention); or
   b. Based on differences between groups of individuals or clusters receiving either the intervention of interest or a comparator (this includes comparing the extent of change over time between groups).

This group contains a set of studies that use methods to control for confounding in design or analysis and allow, in principle, for any confounding (e.g. randomised trials) and those which, in principle, allow for the control of time-invariant unobserved confounding (e.g. studies based on difference-in-difference analysis; Reeves 2017). Specific study designs in this group include: RCTs, quasi-RCTs, controlled before-and-after (CBA) studies, interrupted-time-

series (ITS) studies, and controlled interrupted-time-series (cITS) studies, as well as instrumental variable (IV) studies and regression discontinuity (RD) designs (Reeves 2017).

This group may also contain a set of studies which, through design, analysis or both, only allow for controlling on the basis of observed covariates, and are therefore more prone to bias. This includes cross-sectional studies, cohort studies (retrospective, non-concurrent, and prospective), and case-control studies (retrospective and prospective). As study design labels are used inconsistently and distinctions between these are often not clear-cut based on how studies assess and report their data, we classified the studies based on their design features, following the characterisation of these features by Reeves 2017. For example, Reeves 2017 define a retrospective cohort study as “a cohort study in which subjects are identified from historic records and classified as having received the intervention or comparator of interest on the basis of the historic information”.

Modelling studies

Within the second group, we included mathematical modelling studies, which we defined as a “mathematical framework [s] representing variables and their interrelationships to describe observed phenomena or predict future events” (Eykhoff 1974). This includes mechanistic models (models of systems representing causal mechanisms), empirical models (models predicting outcomes from input data), and hybrid models (models combining mechanistic with empirical approaches). Among others, this could include probabilistic and deterministic compartmental models (e.g. traditional SEIR (Susceptible-Exposed-Infected-Recovered) models, agent-based epidemiologic models or Bayesian hierarchical models (i.e. models comprising several sub-models to integrate observed data and uncertainty)).

In line with the GRADE guidance on approaches to assessing the certainty of modelled evidence, we did not include statistical models used to estimate the associations between measured variables (e.g. proportional hazards models or models used for meta-analysis; Brozek 2021).

We considered studies published in scientific journals, as well as those published on preprint servers (e.g. medRxiv) and in the grey literature. We reported studies that had been registered but not yet published (in a peer-reviewed journal or on a preprint server) as 'ongoing studies.'

We excluded the following types of study and publication:

- Studies that did not provide a quantitative measure of impact (e.g. qualitative studies)
- Diagnostic test accuracy studies (e.g. studies that assessed the sensitivity and specificity of different screening tests)
- Publications that do not provide primary empirical data on the outcomes of interest (e.g. commentaries, editorials, literature reviews not reporting primary empirical data)
- Systematic reviews and literature reviews (although we used relevant reviews for backward and forward citation tracking)
- Conference abstracts and summary reports, since these did not report sufficient data on population, intervention, comparison, outcomes, and settings to allow for an assessment of their eligibility.

We excluded studies that reported quantitative data without a control group or counterfactual.

Types of settings

For this review, we focused on interventions implemented in the setting of long-term care facilities. In the context of this work, we define long-term care facilities as residential institutions that take care of people who require support because they experience difficulties living independently in the community. These difficulties arise from the interaction between barriers in their environment and physical, mental, intellectual or sensory impairments, often related to old age or chronic medical conditions. We used the term, 'long-term care facility' to encompass long-term care facilities, skilled nursing facilities, nursing homes, retirement homes, assisted-living facilities, residential care homes and other similar facilities and institutions (ECDC 2020).

Within this review, we define the setting of long-term care facilities broadly to encompass both the physical space of the facility itself and the spaces and activities beyond it that have direct implications for care practice. Measures could be implemented either within the building and its premises (e.g. hygiene measures) or outside the facility, if they target structures or institutions standing in direct relation to the residents, or the long-term care facilities' staff, and visitors. This could include regulations that prohibit residents from leaving the premises or taking part in activities, such as public religious services outside the facility, as well as those that affect staffing levels in facilities or visitors.

We did not include home care and related settings, where an individual receive s nursing care or other medical and social support through family members, home care nursing or social services, but does not reside within a long-term care facility.

We excluded studies that reported on measures implemented in institutions primarily or exclusively providing acute care (e.g. hospitals), rehabilitative care (e.g. rehabilitation centres), or specialised palliative care (e.g. hospices). We also excluded long-term care facilities that were primarily or exclusively focused on paediatric populations, that is, if more than 75% of the population was under 18 years old.

We included modelling studies that operationalised a virtual setting simulated after, or with a high degree of similarity to, measures implemented in real-world long-term care facility settings. All modelling studies that provide an assessment of the impact of measures implemented in long-term care facilities make some assumptions to simulate the real world. These assumptions relate to aspects such as the intervention itself, the operationalisation of the facility, the population living or working in the facility, and their interaction with the general population. Studies in which most of these aspects use simplistic or conceptual assumptions, however, tend to provide abstract findings that cannot readily be interpreted or applied. We feel that mainly theoretical studies are not sufficiently informative for decision-makers. We therefore only included modelling studies that were based on structural and parameter assumptions, which we judged to be sufficiently informative for practice in long-term care facilities. Where this judgement was not clear, the review author team discussed the case and made a decision about eligibility.

Types of populations

Particular populations of interest were:

- adult residents living in long-term care facilities (≥ 18 years of age);
- staff working in the setting of long-term care facilities.

This includes both nursing staff and non-nursing staff working in the setting of long-term care facilities on a regular basis (e.g. kitchen staff, physiotherapists), as well as individuals or groups who visit the setting of long-term care facilities on a less regular basis for work-related purposes (e.g. primary care physicians, long-term care facility inspectors, social workers).

While we excluded the setting of specialised institutions primarily intended to provide palliative care, we included populations receiving palliative care in a long-term care facility. We did not look at paediatric populations living in nursing homes, and excluded studies that were primarily or exclusively focused on paediatric populations.

We excluded studies that assessed the impact of measures implemented in the setting of long-term care facilities for the wider community (e.g. modelling studies that assessed the implications of closing long-term care facilities for national transmission dynamics) if they did not provide specific data for at least one of the two population groups of interest.

Types of interventions

We included studies that assessed the impact of non-pharmacological measures that aimed to protect populations living in long-term care facilities from SARS-CoV-2 infection, the consequences of the COVID-19 disease, or both. The measures had to be implemented in the setting of long-term care facilities (as defined above).

In line with the a priori logic model, the review included measures aiming to reduce SARS-CoV-2 infections and prevent or mitigate the consequences of COVID-19 disease in the four domains:

1. entry regulations;
2. contact-regulating and transmission-reducing measures;
3. surveillance measures; and
4. outbreak control measures;

and the categories of measures within them.

1. Entry regulation measures (E)

These are measures to prevent infectious individuals such as staff, visitors and residents from (re-)entering the setting of long-term care facilities.

1. **Full or partial closure of the facility to the outside (E1)**: organisational, regulatory and educational measures, which reduce or restrict access to all or some individuals. These could be based on individual characteristics (e.g. individuals showing symptoms of respiratory tract infection without active screening) or on roles and functions within the facility (e.g. not allowing any non-work-related visits, restricting access to individuals providing non-essential services in the facility, such as hairdressing).
2. **Measures intended to reduce viral introduction through facility staff (E2)**: organisational, regulatory and educational measures intended to reduce the probability of viral introduction through focusing on staff at elevated risk of carrying an infection (e.g. staff members with symptoms typical of COVID-19, staff members working in multiple long-term care facilities); preventing these staff members from entering the facility or allowing them to abstain from entering the facility (e.g. provision of staff sick leave).
3. **Measures intended to reduce introduction through residents (E3)**: organisational, regulatory and educational measures intended to reduce the probability of viral introduction by focusing on residents at elevated risk of being infected (e.g. residents returning after being hospitalised). This could include a combination of testing and quarantine (e.g. 14-day, single room quarantine with polymerase chain reaction (PCR) testing on day 1 and day 14).
4. **Pre-entry screening and testing (E4)**: active screening and testing measures intended to detect individuals who are infected with SARS-CoV-2 or who are at an elevated risk of being infected with SARS-CoV-2, including measures in place to prevent individuals who tested or screened positive from entering the facility (e.g. providing antigen-based rapid tests to all visitors prior to entering the LTCF and prohibiting access to those who tested positive).

2. Contact-regulating and transmission-reducing measures (C)

These are measures intended to prevent or reduce the risk of infection among residents, nursing staff, non-nursing staff and visitors through reducing the number of contacts with potential for transmission or reducing the risk of transmission upon contact occurring.

1. **Organisational measures limiting contact and transmission within long-term care facilities (C1):** organisational, regulatory or educational measures to prevent transmission through limiting the number of contacts and reducing the probability of transmission within the facility. This could include measures focused on preventing transmission between staff members in activities and spaces not directly related to providing care to residents, such as care planning, handover between shifts, preparation and documentation activities, breaks (e.g. introducing staggered break and working hours or shift handovers through video calls). This could also include measures to prevent transmission among residents and between residents, staff members and visitors in (leisure) activities and spaces not directly related to providing care or services to residents, such as in the common or dining rooms, during social activities (e.g. by implementing social distancing measures in dining rooms or providing single rooms).
2. **Cohorting within the facility (C2)**: organisational, regulatory or educational measures intended to limit the spread of SARS-CoV-2 within the facility through an unknown source of infection. This is done through creating groups of staff and residents and limiting contact and exposure between these groups (e.g. limiting nursing staff to individual cohorts of residents).
3. **Usage of protective equipment to limit contact and transmission within long-term care facilities (C3):** organisational, regulatory or educational measures intended to reduce the risk of transmission through provision and correct usage of protective equipment and clothing, and personal

hygiene (e.g. guidelines or regulations on the wearing of masks by nursing staff when interacting with residents; regulations on handwashing; training on the correct use of masks).

4. **Technical devices and changing the physical environment to limit contact and transmission within long-term care facilities (C4):** measures intended to reduce the risk of transmission through the air and from surfaces by changing the physical environment (e.g. the use of air filters; usage of antiseptic equipment and furniture; introduction of physical barriers to limit direct contact between residents and visitors).

3. Surveillance measures (S):

These are measures to detect infections among residents and staff to limit secondary infections and reduce outbreak size.

1. **Surveillance testing and screening of staff and residents using PCR-based tests (S1) or point-of-care tests (S2):** active screening and testing measures intended to detect individuals who are infected with SARS-CoV-2 or who are at elevated risk of being infected with SARS-CoV-2, including measures in place to prevent secondary infections (e.g. quarantine for those who were found to have elevated body temperature). Screening and testing is not related to entry into the facility and is intended to identify infections early where there is no known case in the facility at the time point of surveillance testing (e.g. weekly testing of all residents with antigen tests).

4. Outbreak control measures (O)

These are measures to interrupt or prevent further spread or an outbreak after a case of COVID-19 is detected within the facility.

1. **Symptom-based targeted testing approaches of staff and residents (O1):** testing strategy in the case of an outbreak intended to interrupt or prevent further spread after an infected individual is detected within a long-term care facility through focusing on symptom-based testing of individuals.
2. **Generalised testing approaches of staff and residents (O2):** testing strategy in the case of an outbreak intended to interrupt or prevent further spread after an infected individual is detected within a long-term care facility through employing a testing strategy other than symptom-based testing (e.g. testing all individuals in the same ward as the index case multiple times for two weeks).
3. **Contact-tracing and testing approaches of staff and residents (O3):** organisational, regulatory or educational measures intended to isolate individuals with known infections (including isolating staff members, such as through sick leave), as well as quarantining individuals who are at an elevated risk of infection. This could include conducting contact-tracing in combination with focused quarantine of contacts of infected individuals.

This was not considered an exhaustive list of measures but rather a broad overview of the category types we assumed the measures would fall into. We also anticipated that many of these interventions would be implemented in combination with one another. We therefore also included studies that reported on combinations of these measures.

We excluded studies if:

- They did not assess or allow us to determine the impact of non-pharmacological measures or their components; or
- They only described measures not directly intended to reduce the transmission of SARS-CoV-2 (e.g. video calls to relatives introduced as a measure to reduce loneliness among residents); or
- They described the interventions detailed above, but did not implement them in the setting of long-term care facilities. This includes a range of containment and mitigation measures (e.g. community-based quarantine, bans on mass gatherings, or regulation on personal protective measures, hygiene behaviours, and other social-distancing measures aimed at the general population).

We excluded studies that assessed measures that aimed to reduce the adverse effects of protective measures (i.e. smartphone apps or video calls to reduce isolation). We excluded studies that did not assess an intervention but explored institutional-level risk factors for transmission-related outcomes in long-term care facilities (e.g. cross-sectional studies that assessed the relationship between staffing levels and mortality risks). We defined risk factors as those characteristics of long-term care facilities or practices within them that were in place before the pandemic, not specifically implemented with the intention to reduce SARS-CoV-2 infection and COVID-19 disease, and which were assessed as variables that potentially explain differences in SARS-CoV-2 infections and COVID-19 morbidity between long-term care facilities.

Types of comparators

W e included studies that provided data on the following comparisons.

- Measure versus no measure (e.g. a scenario of daily pre-entry testing of staff compared to a scenario without testing)
- More stringent versus less stringent implementation of a measure (e.g. a scenario of daily PCR testing of staff compared to a scenario where only weekly testing was conducted)
- Measure versus alternative measure (e.g. a scenario of daily pre-entry testing of staff using RT-PCR (reverse transcription-polymerase chain reaction)-based tests compared to restricting visitor access to the facility).
- Earlier versus later implementation of a measure (e.g. conducting a general testing approach earlier or later after an index case has been identified in a facility).

Types of outcome measures

Primary outcomes

In line with the WHO-INTEGRATE COVID-19 (WICID) framework (Stratil 2020), which aims to support evidence-informed decision-making on non-pharmacological measures targeting COVID-19, we considered studies that assessed any of the following COVID-19-related outcomes and health-related adverse or unintended effects:

- **SARS-CoV-2 infections avoided due to the measure:** e.g. number, proportion, rate of SARS-CoV-2 infections observed or predicted in long-term care facilities with and without the measure
- **Contaminations of long-term care facilities avoided due to the measure**: in this context, contamination of long-term care

facilities refers to facilities with at least one infection in the observation period (e.g. number, proportion, rate of facilities with less than one SARS-CoV-2 infection observed or predicted in facilities with and without the measure)

- **Outbreaks in long-term care facilities avoided due to the measure:** an outbreak refers to long-term care facilities with more than one SARS-CoV-2 infection from the same source; that is, a situation in which an index case in a facility has caused at least one additional infection (e.g. number, proportion, rate of long-term care facilities with an outbreak (> 1 SARS-CoV-2 infection from the same source) observed or predicted in facilities with and without the measure)
- **COVID-19-related hospitalisations avoided due to the measure:** e.g. number, proportion, rate of hospitalisations due to severe COVID-19 infections observed or predicted in facilities with and without the intervention
- **COVID-19-related deaths avoided due to the measure:** e.g. number, proportion, rate of deaths of people infected with SARS-CoV-2 observed or predicted in facilities with and without the intervention
- **Adverse and other unintended mental or physical health outcomes:** e.g. rate of residents experiencing loneliness; incidence or severity of depression; rate of psychogeriatric hospitalisations, health-related quality of life, changes in health-related behaviour or metabolic risk factors, such as weight change or smoking behaviour

Secondary outcomes

We did not assess any secondary outcomes in this review.

Other outcome-related considerations

We excluded publications that reported on (intended and unintended) societal or ecological outcomes (e.g. changes in waste production or energy consumption), economic or financial outcomes (e.g. costs or resource use associated with an intervention) or other implementation-related outcomes (e.g. reported acceptability or adherence to the measure, reported barriers for implementation) without reporting on any of the primary outcome categories.

Search methods for identification of relevant studies

We structured our search strategy around two main search components focused on SARS-CoV-2/COVID-19, and terms describing the long-term care facility setting and related populations. For COVID-19 topic databases, we only included terms describing the long-term care facility setting and related populations in the search. We developed the search strategy with a Cochrane Information Specialist (IM), and adapted it to other databases. A second Information Specialist peer reviewed the search strategy, following the Peer Review of Electronic Search Strategies (PRESS) guidance (McGowan 2015).

An experienced Cochrnae Information Specialist (IM) adapted and ran systematic searches in the following COVID-19-specific databases and general electronic databases. We limited the results to the years 2020 and 2021, the time period during which studies on long-term care facilities and COVID-19 were published. The search was conducted on 22 January 2021.

- The Cochrane COVID-19 Study Register (covid-19.cochrane.org/) is a specialised register built within the Cochrane Register of Studies (CRS) and maintained by Cochrane Information Specialists. The register contains study reports from several sources:
- daily searches of MEDLINE (PubMed);
- daily searches of ClinicalTrials.gov;
- weekly searches of Embase.com;
- weekly searches of medRxiv;
- weekly searches of the WHO International Clinical Trials Registry Platform (ICTRP);
- monthly searches of the Cochrane Central Register of Controlled Trials (CENTRAL).
- The WHO COVID-19 Global literature on coronavirus disease is a specialised register maintained by WHO information specialists, which aims to provide a comprehensive multilingual source of current literature on the topic. The database is updated daily (Monday to Friday) from searches of bibliographic databases, handsearching, and the addition of other expert-referred scientific articles (search.bvsalud.org/global-literature-on-novel-coronavirus-2019-ncov/).
- Web of Science Core Collection:
  * Science Citation Index Expanded
  * Emerging Sources Citation Index
- CINAHL (via EBSCO)

See Appendix 2 for the full search strategy.

Finally, we conducted forward and backward citation searches of all relevant systematic and literature reviews and guidelines identified through the searches, as well as all included studies. We conducted these searches in Scopus (published studies) and Microsoft Academic (preprints). To retrieve grey literature of unpublished reports or studies not published through traditional publication platforms, we searched Google Scholar. In this search, we screened the first 10 pages of relevancy-ranked results (i.e. the first 100 web pages).

Data collection and analysis

Study selection

We de-duplicated the publications identified through the database searches using EndNote and further by hand (EndNote 2013). Next, two review authors independently screened all titles and abstracts, excluding only those studies that were clearly irrelevant. We moved publications that were marked as unclear forward to the next stage of full-text screening. We used standardised screening guidance based on the eligibility criteria and conducted a calibration exercise with all review authors involved in title and abstract screening. The two screening review authors discussed any discrepancies, classified as 'unclear' those cases that could not be resolved, and forwarded these to the next stage.

Two review authors independently conducted the full-text screening. They resolved discrepancies through discussion in the presence of at least one other review author. At this stage, the review authors made a final decision regarding eligibility. Prior to starting the screening process, all review authors involved with full-text screening screened a set of 10 studies (Garritty 2020; Garritty 2021). The team discussed any open questions or issues and

adapted the screening guidance accordingly, in order to harmonise screening across all review authors.

We used EndNote to manage collection of records. For title and abstract screening, we used the web-based application Rayyan (Ouzzani 2016), which was designed for citation screening for systematic reviews. We used a form in Microsoft Excel to document and report reasons for the exclusion of full texts.

Inclusion of non-English language studies

We considered studies published in Armenian, English, French, German, Italian, Russian and Spanish, based on the language skills within the review team. We excluded studies in languages other than those listed.

Data extraction and management

One review author extracted study characteristics and data from all included studies using a predeveloped and validated data extraction form in Microsoft Excel. A second review author checked all extracted data. All review authors involved in the data extraction independently extracted three studies, deliberately selected for variation, that met the inclusion criteria; they discussed their extractions as part of a calibration exercise.

We included the following main categories in the extraction form, including relevant subcategories (see data extraction items in Appendix 3).

- Study information
- Study design
- Population and setting
- Intervention
- Outcomes and results
- Context and implementation

Assessment of risk of bias and quality of included studies

Two review authors rated the risk of bias or quality of each included study independently, using different tools depending on the type of study. They discussed any conflicts, questions, or uncertainties between themselves and, where necessary, with the review team. The review authors carried out the assessment using templates created in Microsoft Excel.

Assessment of risk of bias in randomised controlled trials

For the assessment of the risk of bias in experimental studies, we had planned to apply the Cochrane RoB 2 tool and its adaptation for cluster-RCTs (Higgins 2021a). However, we did not identify any experimental studies for inclusion in this review.

Assessment of risk of bias in non-randomised studies of the effects of interventions

For the assessment of the risk of bias of non-randomised studies of the effects of interventions (NRSIs), except for cross-sectional studies, we used the most recent version of the ROBINS-I tool (Risk Of Bias In Non-randomised Studies of Interventions ; Sterne 2016a; Sterne 2020). This tool is concerned with evaluating the risk of bias of NRSIs; these include quantitative studies estimating the effect (harm or benefit) of interventions that did not use randomisation to allocate units to comparison groups to compare the health effects of two or more conditions (Sterne 2016b). The terminology around such studies is often used inconsistently, and sometimes incorrectly; relevant terms sometimes used include quasi-randomised studies, quasi-experimental studies, natural experiment studies and observational studies, among others. The base version of the tool is primarily concerned with studies in which participants are followed up from the start of an intervention up to a later time for ascertainment of outcomes of interest, so-called follow-up studies or cohort-like designs (Sterne 2016b). The developers of the tool note that, while much of the material is also relevant to designs such as case-control studies, cross-sectional studies, ITS studies and CBA studies, modifications to the signalling questions are required for these other types of studies (Sterne 2016b). Therefore, we followed the guidance laid out in chapter 25 in the Cochrane Handbook for Systematic Reviews of Interventions on how to address additional or different issues relating to risk of bias assessment including ITS studies, CBA and cITS studies (Sterne 2020).

As there is no guidance on how to adapt the ROBINS-I tool for cross-sectional studies and case-control studies, we used the Joanna Briggs Institute (JBI) Critical Appraisal Checklist for Analytical Cross-Sectional Studies and the JBI Critical Appraisal Checklist for Case-Control Studies, respectively (Moola 2017).

In applying the ROBINS-I and JBI tools, it is important to define a priori the important confounding factors that, ideally, each study would control for. We predefined the relevant domains for confounding factors in the logic model, including the following:

- intra-individual risk and protective factors;
- underlying risk factors for infections/outbreaks in long-term care facilities;
- risk of infection outside long-term care facilities;
- factors relating to social practices;
- testing-related factors of influence; and
- general implementation factors.

Relevant co-interventions that could lead to bias should also be considered when assessing the risk of bias in such studies. In principle, any number of co-interventions applied in long-term care facilities or in the wider community, if applied differently between comparator arms, could lead to bias. However, there is no accepted standard care in long-term care facilities, and practices are likely highly context-dependent; thus, we did not define these concretely a priori. We listed important co-interventions for each included study before conducting the risk of bias assessment, based on the intervention domains or categories defined in the review protocol (Sterne 2020).

When using ROBINS-I, the effect of interest can either be the effect of assignment to the interventions at baseline or the effect of adhering to the interventions (Sterne 2016a; Sterne 2016b). As we were interested in the overall effect of implementing measures in long-term care facilities, not only in the effect of compliance of individuals or long-term care facilities, we assessed the effect of the assignment of the intervention at baseline.

JBI critical appraisal checklist for analytical cross-sectional studies

The JBI checklist for cross-sectional studies includes domains referring to:

- inclusion criteria;

- description of the study population;
- validity and reliability of the measurement of the exposure (i.e. the intervention in the case of this review);
- objective measurement of the condition of interest;
- identification of confounding factors;
- approach to handling confounders;
- reliability and validity of outcome measurements; and
- appropriateness of the statistical analysis (Moola 2017).

JBI critical appraisal checklist for case-control studies

The JBI checklist for case-control studies includes domains referring to:

- comparability of cases and controls;
- appropriateness of the process for matching cases and controls;
- differences in the approaches for identifying cases and controls;
- standardisation, validity and reliability of the measurement of the exposure (i.e. the intervention in the case of this review);
- differences in the measurement of exposure between cases and controls;
- identification of confounding factors;
- approach to handling confounders;
- standardisation, reliability and validity of outcome measurements;
- sufficient length of the observation period; and
- appropriateness of the statistical analysis (Moola 2017).

For both the JBI checklists, the respective indicator questions are to be answered with 'yes', 'no', 'unclear', and 'not applicable'. To align the rating with the ratings used within ROBINS-I, we additionally assigned a rating of 'low risk of bias', 'moderate risk of bias', 'serious risk of bias', and 'critical risk of bias' to each of the eight categories. In reaching an overall risk of bias judgement for a specific outcome in an individual study assessed with these JBI checklists, we applied the following criteria.

- Low risk of bias: we judged the study to be at low risk of bias for all domains.
- Moderate risk of bias: we judged the study to be at low or moderate risk of bias for all domains.
- Serious risk of bias: we judged the study to be at serious risk of bias in at least one domain, but not at critical risk of bias in any domain.
- Critical risk of bias: we judged the study to be at critical risk of bias in at least one domain.

ROBINS-I tool

The ROBINS-I tool includes domains relating to bias:

- due to confounding;
- in selection of participants into the study;
- in classification of interventions;
- due to deviations from intended interventions;
- due to missing data;
- in measurement of the outcome; and
- in selection of the reported result.

Based on answers to the signalling questions, judgements for each bias domain can be 'low', 'moderate', 'serious', or 'critical' risk of bias.

In reaching an overall risk of bias judgement for a specific outcome in an individual study, we applied the following criteria.

- Low risk of bias: we judged the study to be at low risk of bias for all domains for this result.
- Moderate risk of bias: we judged the study to be at low or moderate risk of bias for all domains.
- Serious risk of bias: we judged the study to be at serious risk of bias in at least one domain, but not at critical risk of bias in any domain, or has moderate risk of bias in multiple domains and is therefore considered to be at serious risk of bias.
- Critical risk of bias: we judged the study to be at critical risk of bias in at least one domain.

We further summarised the risk of bias for a body of evidence on an outcome across studies as part of the GRADE rating. We assessed this evidence as follows.

- Low risk of bias: most evidence for the outcome was from studies at low risk of bias.
- Moderate risk of bias: most evidence was from studies at low or moderate risk of bias.
- High risk of bias: the proportion of evidence from studies at serious or critical risk of bias was sufficient to affect the interpretation of results.

Assessment of the quality of modelling studies

There is currently no standard method for appraising the quality of modelling studies within the systematic review community. In their rapid review of travel-related control measures, Burns 2021 describe the challenge of critically appraising modelling studies by referring to a rapid review of the methodological literature that sought to identify and summarise studies describing criteria for assessing the quality of mathematical studies (Egger 2017). This review suggested that an assessment of the quality of a modelling study should capture the aspects of:

- model structure;
- input data;
- different dimensions of uncertainty;
- transparency ;
- external validation; and
- internal validation.

This tool does not combine multiple criteria into a summary score (Appendix 4 Burns 2021; Egger 2017). Based on these findings, Burns 2021 developed a tool for the assessment of modelling studies. This tool has been applied in the update of the Burns 2021 review, and the review by Krishnaratne 2020. We also applied this tool in our Cochrane Review (Appendix 4). It covers the following aspects:

- model structure;
- input data;
- external validation;
- internal validation;

- uncertainty; and
- transparency.

Using this bespoke tool, we rated each of these aspects as 'no/minor concerns', 'moderate concerns', 'major concerns', or 'critical concerns'. For modelling studies, review authors with modelling expertise undertook and checked the assessment.

In reaching an overall rating for the quality of an individual study, we applied the following criteria.

- No/minor concerns: we judged the study to have no/minor concerns in model structure, input data, validation (external), and uncertainty; and either no/minor concerns or moderate concerns regarding internal validation and transparency.
- Moderate concerns: we judged the study to have moderate concerns for at least one of the following domains: model structure, input data, or uncertainty, and not to have major concerns in any of these three domains.
- Major concerns: we judged the study to have moderate concerns for multiple domains in a way that substantially lowers confidence in the result, or we judged the study to have major concerns in the domain of uncertainty. In both cases, neither model structure nor input data could be judged to have major concerns.
- Critical concerns: we judged the study to have major concerns regarding model structure or input data, or both.

As for the rating of 'critical risk of bias' in the ROBINS-I tool, a study that had an overall rating of 'critical concerns' was regarded as too problematic to provide any useful evidence on the effects of the intervention, and we did not include such a study in the synthesis.

We also summarised the quality of the body of evidence comprised of modelling studies for each outcome as part of the GRADE rating. We judged a body of evidence for an outcome as follows.

- No/minor concerns: we judged the majority of studies contributing evidence to the outcome to have no/minor concerns, with no studies judged to have major concerns.
- Moderate concerns: we judged the majority of studies contributing evidence to the outcome to have moderate concerns.
- Major concerns: the proportion of information from studies judged to have major concerns was sufficient to affect the interpretation of results.

Definition of minimal thresholds for public health relevancy

The thresholds for the public health relevance of reported effect sizes (corresponding to the minimal patient-relevant differences) are defined in this study as any difference from the null. Given the high disease burden of SARS-CoV-2 in long-term care facilities, we regarded any intervention that allowed for a reduction of infection risk as potentially relevant.

Accordingly, the narrative synthesis and our assessment of the certainty of evidence focus on the existence and direction of effects, rather than the effect size. However, we also provide data on the effect sizes, in order for decision-makers to judge the practical relevance of the intervention effects in light of other criteria.

Measures of intervention effect

Across outcomes, we expected the intervention effects to be reported in a range of estimates or descriptive measures. Therefore, we decided on the most appropriate measure after we extracted data from included studies, but before we began the evidence synthesis.

For continuous outcome measures, such as the number of SARS-CoV-2 infections per 100 residents, the preferred measure of intervention effect was the standardised mean difference (SMD). For dichotomous outcomes, such as the presence or absence of an outbreak in long-term care facilities during the observation period, we used the risk ratio (RR). When provided in the publication, we included 95% confidence intervals (CIs) for all reported intervention effects.

If a study reported both unadjusted and adjusted intervention effects, we used the adjusted effects in conjunction with data on the covariates that the models adjusted for. If a study reported multiple adjusted estimates of an intervention effect, we used the one that we judged to minimise the risk of bias due to confounding (Reeves 2019). Some studies, such as modelling studies and quasi-experimental studies, presented multiple 'main effects' that may be plausible and similar regarding risk of bias. In such cases, we extracted multiple estimates. For studies providing multiple estimates with comparable risk of bias, we used the median of the estimates in a meta-analysis and the direction of effect of the median estimate for vote counting (see below). If there was an even number of estimates, we selected the most conservative estimate closest to the median estimate. For studies reporting measurements with multiple time points for the same primary outcome, we selected the outcome measure with the longest follow-up period from the intervention.

If the study provided different measures for the same outcome, we selected or calculated (if data allowed) the outcome measure which was used or could be calculated in all or most other studies reporting on the same intervention domain and category within the same population group. If there were multiple measures of the same outcome meeting this condition, we chose the one with the lowest risk of bias.

Some studies allowed multiple comparisons. In these cases, we included all comparisons that met the eligibility criteria and selected the comparisons of no measure versus the most stringent implementation of the measure for the summary of findings tables. For studies that assessed different levels of stringency of implementation of the measure, we selected the comparison of the most stringent versus the least stringent implementation.

Assessment of reporting biases

As we prespecified in the review protocol (New Reference), we planned to use funnel plots to assess the risk of reporting bias and perform tests for funnel plot asymmetry (e.g. Egger's tests) if we identified at least 10 studies within the same intervention domain and category that assessed comparable outcomes in the same population group (Page 2021a). However, we did not identify any body of evidence comprised of at least 10 studies, and therefore did not assess the risk of reporting bias.

Data synthesis

Because of limited evidence per comparison and reporting of different effect measures (McKenzie 2021a), we synthesised the findings narratively stratified by intervention type and outcome. We report findings in accordance with the 'Synthesis Without Meta-analysis' (SWiM) reporting guideline (Campbell 2020).

We used vote counting based on the direction of effect (Campbell 2020). We first created tables structured according to the specific comparisons (i.e. corresponding intervention domain/category and comparator) and outcome categories; we populated the tables with the summaries of the effects from each individual study that contributed evidence to the specific outcome within the comparison, and described the potential moderators that the individual studies assessed (e.g. modelling studies that assessed different scenarios by varying certain parameters).

For observational studies, we reported the following characteristics, when data were available in the studies.

- Study ID
- Time point in the pandemic (year and month in which the study was conducted)
- Country of conduct
- Study design
- Key details of intervention
- Key details of comparator or counterfactual
- Key details of underlying protective measures in place in the facility
- Key details about level of community transmission
- Facility type
- Study population and sample size (including age structure)
- Outcome domain and specific outcome measure
- Available data on the effect measure (the data directly reported or calculated from the reported statistics, in terms of, for example, effect estimate, direction of effect, confidence interval, precise P value, or statement regarding statistical significance, that is either statistically significant or not).

For mathematical modelling studies, we reported the following characteristics, when data were available in the studies.

- Study ID
- Country of conduct
- Type of mathematical modelling study
- Key details of the mathematical model
- Key details about how the facilities and their populations were represented in the model
- Key details of how the intervention was operationalised in the model
- Outcome domain and specific outcome measure
- Available data on the effect measure (as described above).

Next, we classified the direction of effect for each study in the tables. These were categorised as showing beneficial or harmful effects, based on the observed direction of effect alone, thereby creating a standardised binary metric. In accordance with our definition of the minimal threshold for the public health relevance of reported effect sizes being any difference from the null, we considered any effects that were different from the null to be beneficial or harmful (i.e. favouring the measure or the control, respectively). Additionally, in order to add further nuance, we consistently applied the terms ‘unclear’ and ‘clear’ effects in our reporting to differentiate effect estimates whose confidence intervals overlap the null (and therefore allow for the possibility of a different direction of effect) from those whose intervals fall on only one side of the null.

We then created summary of findings tables for each comparison. These summarise the directions of effect of the bodies of evidence for each outcome (e.g. proportion of studies showing clear or unclear beneficial effects per each outcome). In line with the SWiM guideline, these summaries also report the ranges of the effect sizes per outcome (Campbell 2020). One of the lead authors prepared the summary and data synthesis, and a second review author checked this for correctness before the review by the research team members.

We visualised the vote counting results by way of effect direction plots (McKenzie 2020; Ogilvie 2008; Thomson 2013).

Dealing with missing data

We did not encounter instances, where missing data on study characteristics or outcome measures limited the use of a study at further stages of the review requiring us to contact the corresponding author.

Assessment of heterogeneity

Describing heterogeneity

We assessed methodological and clinical heterogeneity in a tabular form, documenting the following characteristics of the included studies (when they were reported in the studies).

- Time point in the pandemic (year and month in which the study was conducted)
- Country of conduct
- Study design
- Details of intervention and its implementation
- Details of comparator or counterfactual
- Details of underlying protective measures in place in the facilities
- Details about level of community transmission (e.g. 7-day SARS-CoV-2 incidence at time of conduct)
- Characteristics of the study population (e.g. sex or gender, age groups, ethnicity)
- Outcome domain and specific outcome measure
- Available data on the effect measure (the data directly reported or calculated from the reported statistics, in terms of, for example, effect estimate; direction of effect; confidence interval; precise P value; or statement regarding statistical significance).
- Outcome on the standardised binary metric of whether the study reported a beneficial effect or an adverse effect.

Assessing heterogeneity

We did not assess heterogeneity as specified in the review protocol, as no body of evidence met our predefined conditions for such an assessment (i.e. three or more contributing studies showing mixed effects). However, when presenting the review findings,

we documented sources of heterogeneity that could potentially explain the variation in the reported directions and magnitude of effects. These were primarily derived from modelling studies examining multiple scenarios of implementing the measures.

Subgroup analyses and investigation of heterogeneity

We did not conduct subgroup analyses as specified in the review protocol, as bodies of evidence identified in this review did not meet our predefined conditions for such analyses.

Sensitivity analyses

We did not conduct sensitivity analyses as bodies of evidence identified in this review comprised a limited number of contributing studies (mostly one or two contributing studies per outcome).

Assessment of certainty of evidence

We used the GRADE approach to assess the certainty of evidence (GRADE 2013; Hultcrantz 2017). One review author collated the evidence for each primary outcome category and developed a preliminary assessment of the certainty of evidence. The evidence and preliminary assessments were then shared with other review authors, and the review team made a joint decision regarding the certainty of evidence ratings.

The certainty of evidence is defined in GRADE as the extent to which one can be confident that the true effect of an intervention lies on one side of a specified threshold, or within a chosen range (GRADE 2013; Hultcrantz 2017). In this rapid review, we considered 'difference from the null' as an important threshold assuming that even small effect sizes may be relevant for measures implemented in long-term care facilities. The certainty of evidence rating in GRADE yields four possible levels of evidence: high certainty (i.e. the estimated effect lies close to the true effect), moderate certainty (i.e. the estimated effect is probably close to the true effect), low certainty (i.e. the estimated effect might substantially differ from the true effect), and very low certainty (i.e. the estimated effect is probably substantially different from the true effect; GRADE 2013; Hultcrantz 2017).

We rated bodies of evidence from the two groups of studies we specified above, namely, experimental and quasi-experimental studies (i.e. CBAs and ITS), and other observational studies of intervention effect, and mathematical modelling studies, separately. In GRADE, evidence from RCTs enters the rating as high certainty, as does evidence from observational studies whose risk of bias has been assessed using ROBINS-I (Schünemann 2019). Further to this, five domains are used to further downgrade evidence, including study limitations, inconsistency, indirectness, imprecision, and publication bias; three domains are used to upgrade evidence, including plausible confounding, large estimates of effect, and dose-response relationship. These domains apply to assessment of evidence from all types of studies, including modelling studies (GRADE 2013; Hultcrantz 2017).

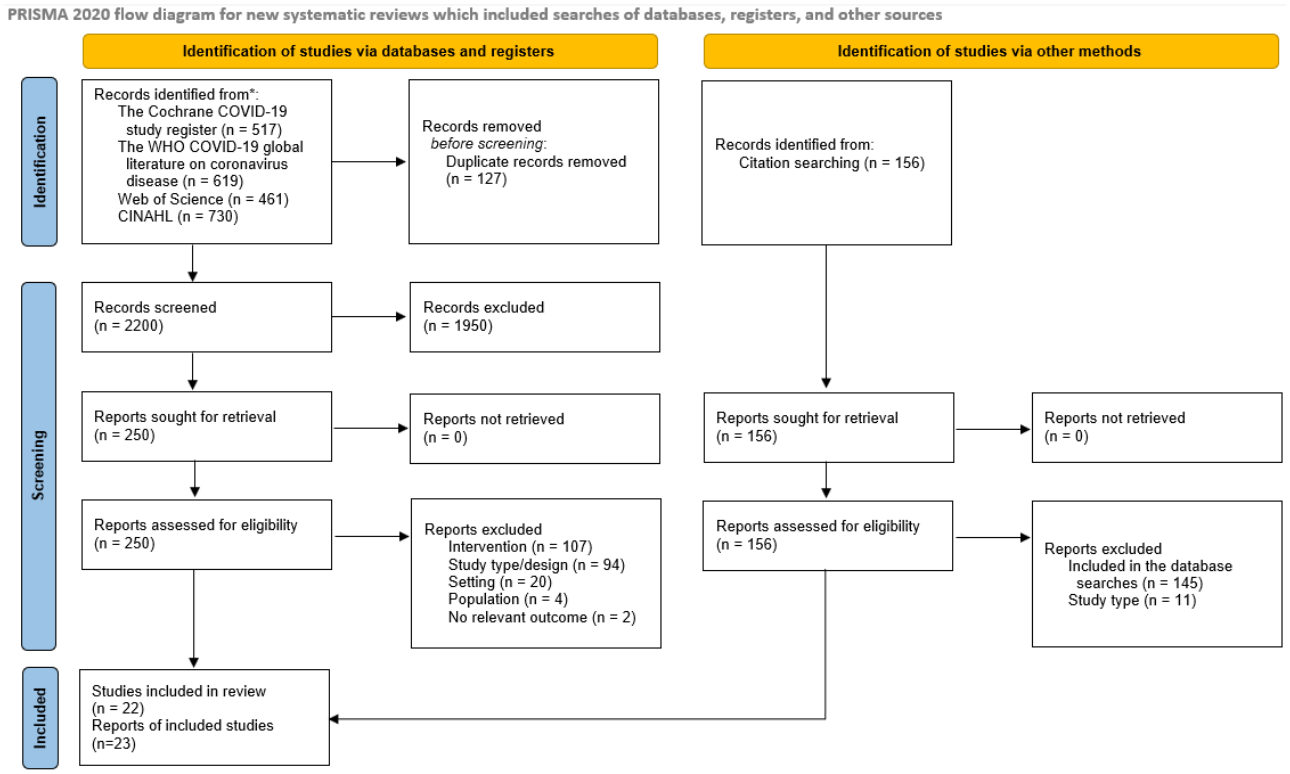
To rate certainty of evidence from modelling studies, we used the recent guidance developed by the GRADE Working Group (Brozek 2021). Evidence from modelling studies also enters the assessment as high certainty, and all the GRADE domains described above are then used to assess certainty of model outputs. We downgraded evidence from modelling studies for study limitations when we identified moderate or major concerns regarding the structural and parameter assumptions of the models; we downgraded evidence for indirectness when we identified concerns regarding the transferability of the model and its structural parameters to the long-term care facility context or for lack of external validation of the model; reasons for downgrading evidence from modelling studies for imprecision included insufficient assessment of uncertainty in the model and wide confidence/credibility intervals crossing the null effect.

RESULTS

Results of the search

The PRISMA flow diagram (Page 2021b), shown in Figure 3, describes the study selection process. For this review, we screened 2200 unique records at the title and abstract stage. We screened the full texts of 261 unique records (250 identified through database searches, 156 identified through citation tracking). Overall, 23 records met the eligibility criteria for this review. Reasons for excluding studies at the full-text screening stage are presented in Figure 3 and further described in the 'Characteristics of excluded studies' table for those studies, the eligibility of which we decided in multiple rounds of discussion among the review authors.

Figure 3. PRISMA 2020 flow diagram for new systematic reviews, which included searches of databases, registers and other sources (Page 2021b)



The 23 records included in the analysis represent 22 unique studies (Belmin 2020; Delaunay 2020; Green 2021; Holmdahl 2021; Knock 2021; Lipsitz 2020; Lombardo 2021; Love 2021; McArthur 2021; Nguyen 2020; Reyné 2020; Rolland 2020; See 2020; Shallcross 2021; Smith 2020a; Smith 2020b; Telford 2020; Telford 2021; Tsoungui 2021; Vijh 2021; Vilches 2020; Wilmink 2020), as the results of one study was reported in two publications (Belmin 2020). The characteristics of each of the 22 studies are described in detail in the 'Characteristics of included studies' and summarised below (Appendix 5; Appendix 6).

For four studies, which were located as preprints through database searches, we identified and included a corresponding publication in a peer-reviewed journal (Holmdahl 2021; Shallcross 2021; Telford 2021; Tsoungui 2021). Three preprint studies had yet to be published in a peer-reviewed journal at the time of writing (Love 2021; Reyné 2020; Vilches 2020).

We identified one ongoing study that had not been yet published (Posar 2020).

Included studies

The 22 studies included in the analysis are described in the following sections.

Setting

The 11 observational studies included in the review assessed measures in long-term care facilities located in Canada (McArthur 2021; Vijh 2021), France (Belmin 2020; Reyné 2020; Rolland 2020), Italy (Lombardo 2021), the UK (Green 2021; Shallcross 2021), and the USA (Lipsitz 2020; Telford 2020; Telford 2021). These studies were conducted within nursing homes (Belmin 2020; Lipsitz 2020; Lombardo 2021; Reyné 2020), care homes (Green 2021; McArthur 2021) or general long-term care facilities (Rolland 2020; Shallcross 2021; Telford 2020; Telford 2021; Vijh 2021) for the elderly. Three studies conducted their investigation within facilities that explicitly offered services for people living with dementia (Lombardo 2021; McArthur 2021; Shallcross 2021). Other studies did not mention this specification.

The 11 included modelling studies described simulated settings, among which two described generic long-term care facilities (Love 2021; Wilmink 2020), while nine were modelled after/according to specific long-term care facilities and/or countries. These countries included: Canada (Delaunay 2020; Vilches 2020), France (Smith 2020a; Smith 2020b), Germany (Tsoungui 2021), the UK (Knock 2021; Nguyen 2020) and the USA (Holmdahl 2021; See 2020).

Population

The studies assessed outcomes of interest in residents (Knock 2021; Lombardo 2021; McArthur 2021; Nguyen 2020), or both residents and staff members (Belmin 2020; Delaunay 2020; Green 2021; Holmdahl 2021; Lipsitz 2020; Love 2021; Reyné 2020; Rolland 2020; See 2020; Shallcross 2021; Smith 2020a; Smith 2020b; Telford 2020; Telford 2021; Tsoungui 2021; Vijh 2021; Vilches 2020; Wilmink 2020). No included study assessed outcomes in staff members only, among visitors or among populations outside the setting of the facility (e.g. family members of visitors or staff, the wider community).

Interventions and comparisons

Included studies referred to a range of measures, which we classified into four intervention domains as per our prespecified logic model: entry regulation measures, contact-regulating and transmission-reducing measures, surveillance measures, and outbreak control measures. We further added one additional domain on multicomponent measures, as the included studies also assessed these. Regarding the more specific categories of measures within each domain, these were derived based on the reporting in the included studies. While some of these corresponded to the categories of measures we prespecified in the review protocol, we identified many new categories.

Entry regulation measures

The studies assessed or modelled different types of entry regulation measures to reduce the risk of introducing SARS-CoV-2 infections into the facility. These included self-confinement of staff members with residents to reduce the risk of staff members introducing infections into the facility (Belmin 2020), restricting the admission of visitors to the facility (Knock 2021; McArthur 2021; Shallcross 2021), 14-day quarantine (Nguyen 2020; Shallcross 2021; Telford 2021), or PCR-based testing for newly admitted or readmitted residents (Smith 2020a; Smith 2020b), and symptom-based entry screening (Telford 2021).

Contact-regulating and transmission - reducing measures

Studies in this intervention domain assessed the effects of a combination of cleaning and environmental hygiene measures (Telford 2021), higher frequency of cleaning (Shallcross 2021; Telford 2021), measures aimed at reducing contacts among residents (Green 2021; Rolland 2020; Telford 2021), and staff (Telford 2021), personal hygiene measures (Rolland 2020; Telford 2021), mask wearing and general personal protective equipment (PPE) usage (Lipsitz 2020; Reyné 2020; Rolland 2020; Shallcross 2021; Telford 2020), cohorting of residents and staff (Holmdahl 2021; Rolland 2020), and combinations of multiple contact-regulating and transmission-reducing measures (Rolland 2020; Love 2021).

Surveillance measures

This intervention domain comprises studies that assessed the effects of regular testing of residents and staff, using both PCR-based (Holmdahl 2021; Nguyen 2020; See 2020; Smith 2020a; Telford 2020; Tsoungui 2021; Vilches 2020), and antigen-based approaches (Holmdahl 2021; See 2020; Tsoungui 2021). The modelling studies allowed for a comparison of different rates of testing (Delaunay 2020; Holmdahl 2021; See 2020; Smith 2020a; Tsoungui 2021; Vilches 2020), levels of test sensitivity (Holmdahl 2021; See 2020; Tsoungui 2021; Vilches 2020), types and shares of the populations being tested (Delaunay 2020; Nguyen 2020; Smith 2020a), turnaround times for PCR tests (i.e. time until results are available; See 2020; Tsoungui 2021; Vilches 2020). Two studies furthermore assessed symptom-based testing (Smith 2020a; Telford 2021).

Outbreak control measures

The studies in this intervention domain focused on measures implemented in the presence of a known outbreak to mitigate its consequences (e.g. in terms of overall size of the outbreak). These included isolating cases and separating them physically from non-infected residents (Holmdahl 2021; Lipsitz 2020; Lombardo 2021; Shallcross 2021; Telford 2021), as well as digital contact tracing (Wilmink 2020), and generalised testing as an outbreak control measure (See 2020).

Multicomponent measures including measures across multiple intervention domains

The studies in this intervention domain combine multiple measures across more than two intervention domains into one multicomponent measure (Lipsitz 2020; Nguyen 2020; Vijh 2021). For example, the study Nguyen 2020 assessed a multicomponent measure, which included visiting restrictions (entry regulation measure), testing of new admissions (entry regulation measure), social distancing (contact-regulating and transmission-reducing measure), and isolation of symptomatic cases (outbreak control measure).

Comparators

For this review, we identified the following intervention-comparator pairs.

Measure (intervention) versus no measure (comparator)

Excluding some modelling studies (e.g. Holmdahl 2021; Tsoungui 2021), most included studies reported implementing baseline infection control measures in the intervention and in the control arms. For example, the study assesses weekly testing of residents and staff independent of symptom status versus not testing, with both intervention and control groups having implemented baseline infection-control measures, such as contact-regulating and transmission-reducing measures or isolation of infected cases (Nguyen 2020).

Measure (intervention) versus an alternative measure (comparator)

Studies assessed one measure against another measure. Both intervention and control arms had implemented baseline infection control measures in all. This comparator was included in the analysis of moderating factors for surveillance-based testing (e.g. surveillance screening using PCR-based tests compared with point-of-care-based tests; Holmdahl 2021).

Earlier implementation of a measure (intervention) versus later implementation (comparator)

Studies assessed the effects of earlier implementation of measures (the intervention) in comparison with a delayed implementation of the measures, that is, longer time for no intervention as the control (e.g. earlier versus later closure of long-term care facilities to visitors (Shallcross 2021), or earlier versus later implementation of generalised mask wearing in an outbreak (Reyné 2020)).

More stringent implementation of a measure (intervention) versus less stringent implementation (comparator)

Studies assessed the effects of a more stringent implementation of measures (the intervention) in comparison with less stringent implementation (the control; e.g. surveillance testing at higher versus lower rates, testing every two days versus every seven, or at higher versus lower sensitivities of the PCR tests (Tsoungui 2021)).

Outcomes

Primary outcomes

We included studies that assessed SARS-CoV-2-related infectious disease outcomes, as well as adverse effects of the measures, which we grouped into the following outcome domains.

1. Infections
2. Contamination of long-term care facilities
3. Outbreaks in long-term care facilities
4. Hospitalisations
5. Deaths
6. Adverse effects

Within outcome domain 1, studies reported on infections with SARS-CoV-2 among residents, staff or both. This includes studies that reported on the overall number or proportion of infections in the observation period as a whole or other shorter time intervals (e.g. over all number and proportion of infection throughout the observational period) ; Belmin 2020; Holmdahl 2021; Lipsitz 2020; Love 2021; Nguyen 2020; Reyné 2020; Shallcross 2021; Wilmink 2020), weekly rate of infections (Lipsitz 2020; See 2020), the number or proportion of long-term care facilities with a large outbreak (i.e. a higher number of cases in an outbreak; Shallcross 2021; Telford 2021), the number of cases upon detection of an outbreak (Delaunay 2020; Smith 2020a; Tsoungui 2021), or the number of cases averted due to the measure (Smith 2020b; Vilches 2020).

Within outcome domain 2, studies reported on contaminations of long-term care facilities, that is, studies reporting on the number or proportion of long-term care facilities with a contamination (i.e. ≥ 1 cases detected in the facility; Belmin 2020; Rolland 2020; Shallcross 2021).

Within outcome domain 3, studies reported on the probability of detecting contamination before any secondary case occurred (Smith 2020a), and the number or proportion of long-term care facilities with an outbreak (Lombardo 2021; Rolland 2020; Shallcross 2021).

For outcome domain 4, we identified outcomes related to the cumulative number of hospitalisations (Love 2021; Telford 2020; Vilches 2020).

For outcome domain 5, studies reported on outcomes related to the overall number of deaths in the observation period (Knock 2021; Love 2021; Telford 2020; Vilches 2020), or weekly rate of deaths (Lipsitz 2020).

For outcome domain 6, we identified one study that reported on the proportion of residents developing depression, behavioural problems or delirium in association with any interventions implemented (McArthur 2021).

It should be noted, that while this review distinguishes between contaminations (long-term care facilities with ≥ 1 cases) and outbreaks (long-term care facilities with ≥ 2 cases), most studies did not do so but referred to outbreaks as long-term care facilities with one case or more (Belmin 2020; Lombardo 2021; Rolland 2020; Shallcross 2021). In these cases, we followed the process-oriented logic of our review and classified outcomes referring to the number or proportion of long-term care facilities with one case or more as contaminations, when referring to the effect of an entry regulation measure, and as outbreaks, when referring to an infection-control or transmission-reducing measure.

Study designs

We identified 11 observational studies (Belmin 2020; Green 2021; Lipsitz 2020; Lombardo 2021; McArthur 2021; Reyné 2020; Rolland 2020; Shallcross 2021; Telford 2020; Telford 2021; Vijh 2021), of which we classified two as interrupted-time-series studies (McArthur 2021; Vijh 2021), seven as (retrospective) cohort studies (Belmin 2020; Green 2021; Lipsitz 2020; Lombardo 2021; Reyné 2020; Shallcross 2021; Telford 2020), and two as case-control studies (Rolland 2020; Telford 2021).

We identified 11 modelling studies across the four intervention domains (Delaunay 2020; Holmdahl 2021; Knock 2021; Love 2021; Nguyen 2020; See 2020; Smith 2020a; Smith 2020b; Tsoungui 2021; Vilches 2020; Wilmink 2020). Eight models were stochastic, agent-based SEIR models (Delaunay 2020; Holmdahl 2021; Knock 2021; Love 2021; Nguyen 2020; Smith 2020a; Smith 2020b; Vilches 2020), two studies were deterministic, compartmental SEIR models (Tsoungui 2021; Wilmink 2020) and one was a Reed-Frost-Model (See 2020). Modelling studies varied in the methodological approach taken; details are presented in the 'Characteristics of included studies' table (Appendix 6).

Risk of bias and quality of included studies

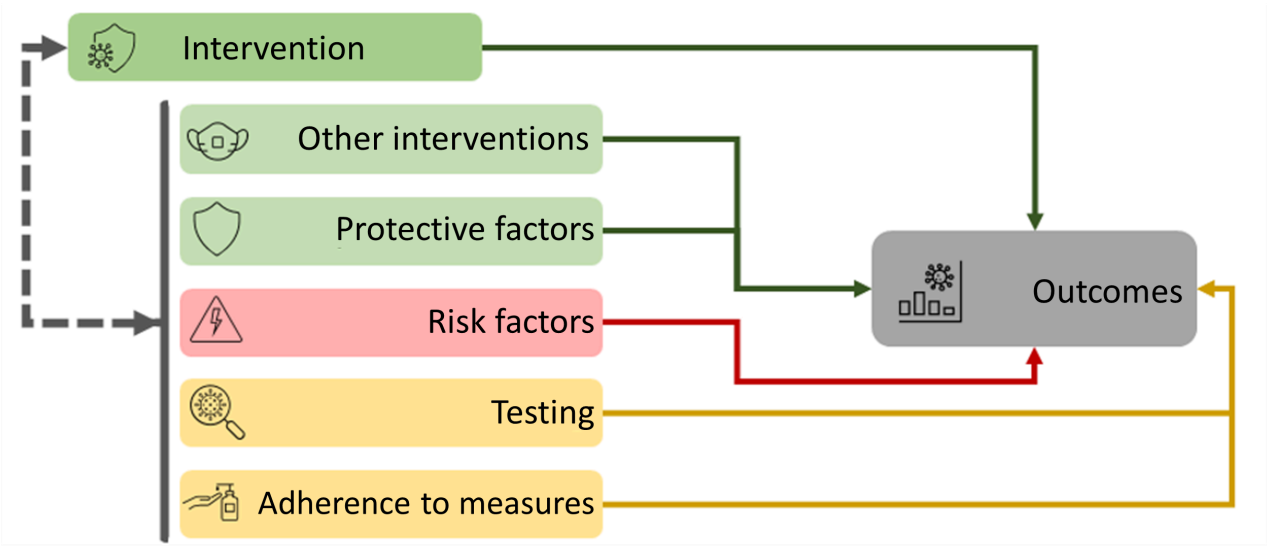
The risk of bias (observational studies) and quality (modelling studies) of included studies is summarised in Table 1, Table 2, and Table 3.

Risk of bias of included observational studies

We assessed the risk of bias of observational cohort studies and interrupted-time-series studies with ROBINS-I (see Table 1). We judged the comparisons in all but one study (Vijh 2021), to have a serious risk of bias, primarily due to the domain 'bias due to confounding'. We judged the domains 'bias in selection of participants into the study', 'bias in classification of intervention', 'bias due to deviation from intended intervention', 'bias due to missing data', 'bias in measurement of outcomes', and 'bias in selection of the reported results' at a mix of low, moderate, serious, and unclear risk of bias.

Most observational studies we judged to have not appropriately measured or controlled for at least one known important confounder, as laid out in the system-based logic model (see Figure 2). In these cases, we judged that it could not be ruled out that observed associations between the measures being assessed and the outcomes of interest could be due to factors associated with the intervention and outcomes. For example, in some cases, long-term care facilities with more financial resources are more likely to have implemented the measure of interest, and to have additional measures in place or to show additional protective factors (e.g. higher staff levels, better ventilation systems) — factors which tended to not be adequately controlled for in included studies. This potential for bias is depicted in Figure 4.

Figure 4. Depiction of the multiple confounders affecting the assessment of intervention effects in the observational studies included in this review. In assessing the relation between the intervention and the outcome, we need to account for a plurality of confounding factors



In several studies, there was limited information regarding the 'bias in selection of participants into the study'. For a number of studies, in which the selection of participants relied on self-selecting processes (e.g. taking part in a voluntary national survey, as in Lombardo 2021), it cannot be ruled out that selection into the study was related to the intervention or the outcome, or both.

In most studies, the intervention status was well-defined. Information was mostly collected retrospectively after the intervention. Collection of information at the time of the intervention occurred less often. In some studies, it was unclear if some aspects of the assignment to intervention status were determined retrospectively, and for other studies the intervention status was not well-defined. This was the case for all cohort studies (Rolland 2020; Telford 2021), and for selected retrospective cohort studies (Green 2021; Lombardo 2021; Shallcross 2021), where the assessment did not allow for a clear distinction on the chronology of events regarding intervention and outcome occurrence.
For most studies, data were reasonably complete, leading to a judgment of low risk of bias due to missing data. In some studies, there was limited information regarding this domain of bias.
For most studies, the methods of outcome assessment were comparable across intervention arms and the outcome was unlikely to be influenced by knowledge of the intervention received, and any error in measuring the outcome was likely unrelated to intervention status. In other studies, it was judged as unclear whether intervention and control groups differed in their approach to testing, which could have led to bias due to outcome assessment.

Most included studies did not refer to a study protocol or a predefined analysis. However, in most cases, the outcome measurements and analyses were clearly defined and both internally and externally consistent (i.e. there was no indication of selection of the reported analysis from among multiple analyses and there was no indication of selection of the cohort or subgroups for analysis and reporting based on these results). In others, there was a clear indication that only measures that showed a statistically significant effect in the conducted analyses were reported, clearly indicating a high risk of selection bias.

We assessed the risk of bias of observational case-control studies with the JBI tool for case-control studies (Moola 2017). We judged all comparisons in both studies as having a serious risk of bias (Rolland 2020; Telford 2021). This was primarily based on a judgment of serious risk of bias regarding the assessment and the approach used to address confounding factors, and serious risk of bias regarding the process of matching cases and controls and their comparability. We judged the comparisons in the two case-control studies to have a low risk of bias in the bias domains of differences in the selection processes of cases and controls, as well as in the domain of having measured the exposure in cases and controls in the same way. We judged the risk of bias regarding the assessment of exposures to be moderate, as we could not rule out that the implementation of the measures could have been a reaction to increasing disease burdens, rather than the intervention preceding the outcome. We judged the risk of bias due to outcome assessment as moderate and serious in the two studies, primarily due to concerns that different testing regimes in the long-term care facilities used to classify facilities as cases and controls could

have biased the findings (Rolland 2020; Telford 2021). Details are provided in Table 2.

Individual judgements for each study can be found in Appendix 7 and Appendix 8 .

Quality of included modelling studies

We appraised the quality of modelling studies using the bespoke tool described in the methods section. We rated the quality of five studies as 'moderate concerns' (Holmdahl 2021; Knock 2021; Nguyen 2020; Smith 2020a; Vilches 2020), one study as 'major concerns' (Smith 2020b), and five studies as 'critical concerns' (Delaunay 2020; Love 2021; See 2020; Tsoungui 2021; Wilmink 2020). Ratings for each study are presented in Table 3.

The rating of the structural and parameter assumptions ranged from 'no/low concerns' to 'major concerns', reflecting the reporting on, the structure of, and the parameters used to populate the models. We judged all studies as 'moderate concerns' or 'major concerns' regarding the external and internal validation of the model due to the common lack thereof. While models can be generally expected to be internally valid to some extent due to an iterative model-building process, externally validating model predictions on real-world data would greatly enhance the credibility of outputs. We judged the adequacy of the assessment of uncertainty as 'moderate concerns' or 'major concerns' in all studies. In most cases, some possibly important domains of uncertainty had not been adequately assessed or reported, which complicates interpretation of uncertainty estimates such as confidence intervals. While we classified this as a requirement for a judgement of 'no/low concerns', we did not consider this a critical flaw that would lead to 'major concerns' or 'critical concerns' in the overall assessment of the quality of the study.

We excluded the studies rated as 'critical concerns' from the evidence synthesis. The judgement of critical concerns in the five studies is based on a rating of 'major concerns' regarding the structural or parameter assumptions in the model (Delaunay 2020; Love 2021; See 2020; Tsoungui 2021; Wilmink 2020), with the model assumptions being judged as biased or too simplistic to provide reliable information (Delaunay 2020; See 2020; Tsoungui 2021; Wilmink 2020).

In Delaunay 2020, the model does not distinguish appropriately between staff members and patients in interaction and transmission probability, the infectiousness is assumed to be constant over the course of an infection, and the model does not account for presymptomatic and asymptomatic cases.

The Reed-Frost model in See 2020 is likely to be too simplistic in describing an outbreak, because the viral dynamic is only described by the reproduction number and discrete generations of the outbreak. Furthermore, the stochasticity (i.e. variability and uncertainty) in important variables such as generation time and symptomatic time is not accounted for.

Tsoungui 2021 treated residents and staff as one single population in the country: the model does not distinguish between individual facilities.

In Wilmink 2020, we judged the operationalisation of the interventions in the model (a deterministic, population based SEIR-type model for 120 agents in an long-term care facility) as too simplistic to provide reliable information on the measures being assessed.

Love 2021 based their model on assumptions about the effectiveness of vaccinations, which later empirical studies (e.g. on outbreaks in long-term care facilities with mostly vaccinated populations) showed to be unreliable. For example, the assumptions about the number of infections to be expected in an outbreak within a facility with residents and staff being fully vaccinated is likely much lower than the model predicted (Cavanaugh 2021).

Individual judgements for each study can be found in Appendix 9 .

Effects of interventions

Entry regulation measures

We included four observational studies (Belmin 2020; McArthur 2021; Shallcross 2021; Telford 2021), and four modelling studies (Knock 2021; Nguyen 2020; Smith 2020a; Smith 2020b), that provided evidence on entry regulation measures, which are depicted in the effect direction plots in Figure 5. A study-by-study overview of the evidence contributing to the outcomes in this intervention domain is presented in Appendix 10.

Figure 5. Direction of effects plot for intervention domain 1: entry regulations

1. Entry regulation measures													
Study ID	Study design	I. Infections			II. Contaminations	III. Outbreaks	IV. Hospitalisations			V. Deaths			VI. AE
		Res.	Staff	Res. & Staff			Res.	Staff	Res. & Staff	Res.	Staff	Res. & Staff	Res.
Intervention category 1. Self-confinement of staff with residents													
Belmin 2020	OBS	▲	▲		▲					▲			
Intervention category 2. Quarantine for new admissions													
Telford 2021	OBS			▲									
Nguyen 2020	MMS	▲											
Intervention category 3. Testing of new admissions													
Smith 2020a	MMS			▲▲									
Intervention category 4. Intensified testing of re-admissions of residents and staff after holidays													
Smith 2020b	MMS			▲									
Intervention category 5. Restricting the admission of new residents													
Shallcross 2021	OBS	▲	●	●	▲								
Intervention category 6. Admission restrictions for visitors													
McArthur 2021	OBS												▲▲▲▼
Shallcross 2021	OBS	▲	▲	▲	▼								
Knock 2021	MMS									▲			

▲: Direction of effect in favour of the measure; ▼: direction of effect in favour of the control; ●: null effect
AE: adverse effects; **MMS**: mathematical modelling study; **OBS**: observational study; **Res.:** residents

Self-confinement of staff with residents

One cohort study provided evidence on the effect of self-confinement of staff members with residents as a measure to prevent the introduction of the virus through staff (Belmin 2020). The evidence from this study suggests that the measure may reduce the number of infections, probability of contamination of the facility, and number of deaths (low-certainty evidence).

Belmin 2020 compared the outcomes in 17 long-term care facilities that implemented voluntary self-confinement, in combination with visiting restrictions and other baseline infection-control measures, with the same outcomes reported in a national survey of 9513 facilities. It showed a clear effect favouring the measure for the number of infections among residents, number of infections among staff members, probability of contamination of facilities, and number of deaths among residents. In total, one out of the 17 long-term care facilities (5.9%) within the intervention group, and 4599 out of the 9513 long-term care facilities (48.3%) in the national survey reported an outbreak (OR 0.07, 95% CI 0.01 to 0.50). In total, five cases of COVID-19 among 1250 residents (0.4%) and 12 cases among 794 staff (1.5%) (confirmed and possible) were registered in the 17 long-term care facilities within the intervention group, and 62,368 infections among 695,060 residents (9.0%) and 29,451 infections among 385,290 staff (7.6%) were recorded in the 9513 long-term care facilities in the national survey that served as a control (both not adjusted for clustering). The odds ratios for the number of infections in the facilities were 0.03 (95% CI 0.02 to 0.10) among residents and 0.19 (95% CI 0.10 to 0.33) among staff (both not adjusted for clustering in the facilities). In total, five COVID-19-related deaths were registered among 1250 residents (0.4%) in the 17 long-term care facilities of the intervention group, and 12,516 deaths were reported among 695,060 residents (1.8%) in 9513 long-term care facilities in the national survey (OR 0.22 95% CI 0.09 to 0.53; not adjusted for clustering).

The one LTCF in the intervention group that reported an outbreak had a known case prior to the implementation of the measure, indicating that the introduction of the SARS-CoV-2 infection had taken place prior to the implementation of the measure. The infections and deaths in the intervention group were reported as having occurred among staff who did not participate in the voluntary self-confinement or in the facility which had reported one case prior to the implementation of the measure.

Quarantine for new admissions

One observational study and one modelling study provided evidence on the effect of a 14-day quarantine for new admissions (Nguyen 2020; Telford 2021). The evidence from the observational study (Telford 2021), indicates that the measure may reduce the number of infections, but the effect is very uncertain (very low-certainty evidence), while the evidence from the modelling study (Nguyen 2020), indicates that measure may reduce the number of infections (low-certainty evidence).

In the observational study (Telford 2021), a case-control study, 24 long-term care facilities with outbreaks were grouped into long-term care facilities with higher and lower numbers of infections in the facility. It showed an unclear effect favouring the measure, with 10 out of 11 long-term care facilities with a high-prevalence outbreak, and 11 out of 13 long-term care facilities

with a low-prevalence outbreak reported to have implemented the intervention (OR 0.83, 95% CI 0.05 to 15.09).

The modelling study Nguyen 2020 predicted a clear effect in favour of the measure regarding the number of infections among residents. Here, the baseline scenario with testing new admissions twice with a PCR-based test in addition to baseline infection control-measures resulted in a mean cumulative number of 53 resident infections per 80 residents after 200 days. The number of infections was lower (difference: 3 infections, 95% CI 1.9 to 3.8) in the scenario with an additional 14-day quarantine for new admissions testing negative twice.

Testing of new admissions

One modelling study reported on the PCR-based testing of residents newly or readmitted to the facility, in order to prevent the introduction of SARS-CoV-2 into the facility (Smith 2020a). This evidence suggests that the measure may reduce the number of infections, but the evidence is very uncertain (very low-certainty evidence).

Smith 2020a reported on the number of infections upon detection of a contamination or an outbreak (i.e. one individual receiving a positive test result) in two models with different parameter assumptions (one built to reflect a facility with 170 residents and one a facility with 30 elderly residents) and predicted an unclear effect favouring the measure in both models. For the model built on a facility with 170 beds, daily PCR-testing of pooled samples (i.e. conducting one PCR-test on a pooled set of multiple samples) predicted a lower number of infections upon detection of an outbreak (median 12 cases, 95% interval: 1 to 79 cases), compared with the baseline scenario in which residents and staff were tested only when they showed severe COVID-19-like symptoms (26 cases upon detection, 95% interval: 1 to 116 cases).

Intensified testing of re-admissions of residents and staff after holidays

One modelling study reported on the number of infections that were averted through intensified re-entry testing of residents and staff after holidays, which is an event with an increased risk of contamination of the facility through residents and staff being infected in the community (Smith 2020b). This evidence suggests that the measure may reduce the number of infections, but the effect is very uncertain (very low-certainty evidence).

Smith 2020b predicted an unclear effect favouring the measure of testing residents and staff (for testing once on day one after the holiday: 40% of cases averted, 95% interval: 0% to 100%; very low-certainty evidence). For the scenarios of testing residents and staff once after holidays, conducting the test on day 1 predicted results comparable with conducting the test on day 4 or on day 7 after the holidays. The scenarios of testing more often predicted favourable results compared with testing less often, with the most effective scenario being the testing of residents and staff on day 1, day 4, and day 7 (mean number of cases averted 83%, 95% interval: : 33% to 100%). At all rates of testing, the study predicted effects favouring testing of residents and staff, compared with testing only residents or only staff.

Restricting the admission of new residents

One observational study provided evidence on the effect of restricting the admission of new residents (Shallcross 2021). This evidence is very uncertain about the measure reducing the number of infections (very low-certainty evidence), but suggests that the measure may reduce the probability of contamination of facilities (low-certainty evidence).

Shallcross 2021 assessed the outcomes for long-term care facilities that had been closed to new admissions early in the pandemic compared with long-term care facilities that delayed implementation of the measure and had therefore received additional admissions. It reported mixed direction of effects for the number of infections and a clear effect favouring the measure for the probability of contamination of facilities.
Relative to the baseline of no new admissions (i.e. restricting the admissions), a higher level of new admissions showed a slight increase in the odds of infections among residents (adjusted odds ratio (aOR) 1.01, 95% CI 1.01 to 1.01), a null effect for infections among staff (aOR 1.00, 95% CI 1.00 to 1.01), and a null effect for the probability of large outbreaks (≥ 20 cases, aOR 1.00, 95% CI 0.99 to 1.02). Regarding the probability of contamination of long-term care facilities, the study showed an increase per each additional unit of admissions relative to the baseline of restricting the admission of new residents (aOR 1.08, 95% CI 1.05 to 1.10).

Admission restrictions for visitors

Two observational studies and one modelling study provided evidence on the effect of entry restrictions for visitors (Knock 2021; McArthur 2021; Shallcross 2021). The evidence from one observational study (Shallcross 2021), suggests that the measure may reduce the number of infections and may increase the probability of contamination of facilities, but the evidence is very uncertain (very low-certainty evidence). The evidence from the modelling study (Knock 2021), suggests that the measure may reduce the number of deaths (low-certainty evidence). Evidence from one observational study (McArthur 2021), is very uncertain about the measure decreasing or increasing the rate of adverse mental health effects among residents (very low-certainty evidence).

The observational study Shallcross 2021 compared the outcomes for the early implementation of the measure with its delayed implementation (i.e. outcome per each additional week of no visitor restrictions). The study reported unclear effects favouring the measures for the number of infections among residents, number of infections among staff, and probability of a large outbreaks (≥ 20 cases). It showed an unclear effect favouring the control for the probability of contamination of facilities. The study showed an increase in the odds of infection among residents (aOR 1.02, 95% CI 1.00 to 1.04) and among staff (aOR 1.02, 95% CI 1.00 to 1.03), as well as for the odds of large outbreaks (≥ 20 cases, aOR 1.06, 95% CI 0.96 to 1.17) for each additional week of delay. Regarding the contamination of long-term care facilities, the study showed a decrease in odds of a facility being contaminated with at least one confirmed case of SARS-CoV-2 for each additional week of delay (aOR 0.99, 95% CI 0.92 to 1.07).

In the observational study McArthur 2021, the measure consisted of restricting visitors from entering the facility in combination with multiple other measures to reduce the adverse effects of the measures on health and well-being of residents (e.g. window

visits and video chats). The study reported unclear effects with mixed direction of effects for adverse and other unintended mental or physical health outcomes. In the study, the residents showed reduced odds of depression (aOR 0.86, 95% CI 0.66 to 1.11) and behavioural problems (aOR 0.88, 95% CI 0.72 to 1.06) during the intervention period compared with the control period. For the adverse outcomes of delirium, residents without dementia showed higher odds of developing delirium (aOR 1.21, 95% CI 0.57 to 2.57), while residents with dementia showed lower odds of developing delirium during the intervention period compared with the control period (aOR 0.29, 95% CI 0.07 to 1.16).

The modelling study Knock 2021 assessed the impact of reducing the contact rate between the general population and facility residents by 50% and predicted a clear effect favouring the measure regarding deaths among residents. It predicted a 44% reduction in "care home deaths" (95% credibility Interval (CrI) 17% to 64%) after six months compared with the baseline scenario with no reduction of the contact rate (the reported care home mortality rates from England).

Contact-regulating and transmission-reducing measures

We included six observational studies (Green 2021; Lipsitz 2020; Reyné 2020; Rolland 2020; Shallcross 2021; Telford 2021), and two modelling studies (Love 2021; Nguyen 2020), that contributed evidence on contact-regulating and transmission-reducing measures. Due to 'critical concerns' in quality, we did not include the modelling study Love 2021, which provided evidence on multi-component contact-regulating and transmission-reducing measures, in the evidence synthesis. Those are depicted in the effect direction plots in Figure 6. A study-by-study overview of the evidence contributing to the outcomes in this intervention domain is presented in Appendix 11.

Figure 6. Direction of effects plot for intervention domain 2: contact-regulating and transmission-reducing measures

2. Contact-regulating and transmission-reducing measures														
Study ID	Study design	I. Infections			II. Contaminations	III. Outbreaks	IV. Hospitalisations			V. Deaths			VI. AE
		Res.	Staff	Res. & Staff			Res.	Staff	Res. & Staff	Res.	Staff	Res. & Staff	Res.
Intervention category 1. Barrier nursing													
Shallcross 2021	OBS	▼	▼	▼		▼							
Intervention category 2. Cleaning and environmental hygiene measures													
Telford 2021	OBS			▲									
Intervention category 3. Frequency of cleaning													
Shallcross 2021	OBS	▲▲▼	▲▼▼	▲▼●		▲▼▼							
Telford 2021	OBS			▼									
Intervention category 4. Contact reduction measures													
Green 2021	OBS					▼							
Rolland 2020	OBS					▲▲▼							
Telford 2021	OBS			▲▲▲									
Intervention category 5. Personal hygiene measures													
Rolland 2020	OBS					▲▲							
Intervention category 6. Mask and PPE usage													
Lipsitz 2020	OBS			▲▲								▲▲	
Reyné 2020	OBS	▲											
Rolland 2020	OBS					▼							
Telford 2021	OBS			▲▲▲▲▲									
Intervention category 7. Cohorting residents and staff													
Rolland 2020	OBS					▲▼							
Holmdahl 2020	MMS	▲	▲										
Intervention category 8. Multicomponent contact and transmission control measures													
Rolland 2020	OBS					▲							

▲: Direction of effect in favour of the measure; ▼: direction of effect in favour of the control; ●: null effect
AE: adverse effects; **MMS**: mathematical modelling study; **PPS**: personal protective equipment; **OBS**: observational study; **Res.:** residents

Barrier nursing

One observational study provided evidence on the effect of barrier nursing (Shallcross 2021). Barrier nursing refers to a set of stringent infection control techniques used in nursing that are intended to protect nursing staff against infection. These measures can range from the use of PPE by staff members to strict isolation of infected individuals using airlocks. In the survey that the study authors conducted, they used the term, 'barrier nursing' without providing a definition or describing the stringency of the respective measures.

The evidence suggests that the measure may increase the number of infections and the probability of outbreaks, but the evidence is very uncertain (very low-certainty).

Shallcross 2021 compared the outcomes in facilities that reported to have implemented the measure with those facilities that reported not to have implemented them. It showed clear effects favouring the control regarding the number of infections among residents, among staff, and the probability of outbreaks, as well as an unclear effect favouring the control for outbreak size when assessing barrier nursing for infected residents. Barrier nursing for all residents showed effects in the same direction for all outcome measures as did barrier nursing for infected residents. For all outcome measures, the study showed unclear effects favouring barrier nursing for all residents compared with barrier nursing for infected residents only.

For example, 1625 long-term care facilities reported an outbreak out of the 2046 long-term care facilities that reported implementing barrier nursing for infected residents. In the comparison group, which reported not implementing this measure, 256 out of 1083 long-term care facilities reported an outbreak (aOR 5.33, 95% CI 4.30 to 6.60). Among the 1742 long-term care facilities that reported implementing barrier nursing for all residents, 1196 reported an outbreak, while 685 out of the 1387 long-term care facilities without the measure reported an outbreak (aOR 1.68, 95% CI 1.38 to 2.05).

Cleaning and environmental hygiene measures

One observational study provided evidence on the effect of multicomponent cleaning and environmental hygiene measures. The evidence suggests that the measure may reduce the number of infections, but the evidence is very uncertain (very low-certainty evidence).

The study showed an unclear effect favouring the measure regarding the number of infections in an outbreak (Telford 2021). In the study, the overall cleaning and disinfection implementation score (i.e. more cleaning and disinfection-related measures implemented in facilities) was lower in 11 facilities with a high number of cases in an outbreak (score: 27%), compared with 13 long-term care facilities (score: 36%) with a lower number of cases in an outbreak (P = 0.44).

Higher frequency of cleaning

Two observational studies provided evidence on the effect of higher cleaning frequency compared with lower cleaning frequency (Shallcross 2021 Telford 2021). The evidence is very uncertain about the measure increasing or decreasing the number of infections and the probability of outbreaks (very low-certainty evidence).

Shallcross 2021 compared the outcomes in long-term care facilities reporting a higher frequency of cleaning (at least twice a day) of communal areas, communal touchpoints, and staff rooms with the outcome in long-term care facilities reporting a lower frequency of cleaning (once per day). For the number of infections among residents, among staff, and the probability of having a large outbreak, the study showed mixed effects: one assessment showed a clear effect favouring the measure (for cleaning of communal areas), three assessments showed an unclear effect favouring the measure, one assessment showed a null effect, two assessments showed an unclear effect favouring the control, and one assessment showed a clear effect favouring the control.

Telford 2021 compared 13 long-term care facilities with a relatively higher number of infections against 11 long-term care facilities with a relatively lower number of infections. It showed an unclear effect favouring the control (i.e. low cleaning frequency). The mean cleaning frequency per day was 4.5 in long-term care facilities with a high SARS-CoV-2 prevalence compared to 3.9 in long-term care facilities with a low SARS-CoV-2 prevalence (P = 0.44).

For probability of outbreaks, Shallcross 2021 reported an unclear effect in favour of the measure in one assessment and an unclear effect in favour of the control in two assessments. Specifically, it showed the proportion of long-term care facilities with an outbreak of any size (≥ 1 case) to be higher in one assessment on cleaning frequency of communal areas (aOR 1.05, 95% CI 0.80 to 1.37) and lower in the assessments on cleaning of communal touchpoints (aOR 0.89, 95% CI 0.61 to 1.30) and of staff rooms (aOR 0.98, 95% CI 0.78 to 1.23), among those reporting lower frequency of cleaning compared with those reporting higher frequency of cleaning.

Contact-reduction measures

Three observational studies provided evidence on the effect of contact-reduction measures (Green 2021; Rolland 2020 ; Telford 2021).

The evidence from one study (Telford 2021), suggests that the measure may reduce the number of infections, but the evidence is very uncertain (very low-certainty evidence). Evidence from two studies (Green 2021; Rolland 2020), is very uncertain about whether the measure increases or decreases the probability of outbreaks (very low-certainty evidence).

Telford 2021 showed an unclear effect favouring the resident-focused contact-reduction measure in one assessment (OR 0.78, 95% CI 0.14 to 4.27) regarding the number of infections in facility-wide outbreaks. In two other assessments, it showed a clear effect (OR 0.05, 95% CI 0.00 to 0.53) and an unclear effect (OR 0.28, 95% CI 0.05 to 1.62) favouring the staff-focused contact-reduction measure.

Green 2021 , which compared long-term care facilities restricting shared spaces with those not implementing such restrictions across two measures of 34 long-term care facilities, showed an unclear effect favouring the control (risk ratio (RR) 2.63, 95% CI 0.4 to 18.5).

In three assessments, the case-control study Rolland 2020 showed mixed effects regarding the probability of outbreaks, with two assessments showing an unclear effect favouring resident-focused

contact-reduction measures and one assessment showing an unclear effect favouring the control.

Rolland 2020 reported the odds of having these measures in place in facilities with no outbreak, compared with facilities reporting an outbreak. Facilities without an outbreak had higher odds of implementing contact-reduction measures during the organisation of meals (aOR 0.63, 95% CI 0.34 to 1.15) and group activities (aOR 0.89, 95% CI 0.41 to 1.91) compared with facilities reporting an outbreak. However, facilities with an outbreak were more likely to have implemented the contact-reduction measure of confining residents in their rooms (aOR 1.64, 95% CI 0.49 to 5.76).

Personal hygiene measures

One case-control study with two assessments provided evidence on the effect of personal hygiene measures and practices (Rolland 2020). The evidence suggests that the measure may reduce the probability of outbreaks, but the evidence is very uncertain (very low-certainty evidence). In this study, 89 out of the 94 long-term care facilities without COVID-19 cases (95%), and 27 out of the 30 long-term care facilities with at least one COVID-19 case reported having specific training on hygiene measures for staff in place (aOR 0.71, 95% CI 0.28 to 1.79). In total, 14 out of the 94 long-term care facilities without COVID-19 cases (15%), and two out of the 30 long-term care facilities with at least one COVID-19 case reported having specific dressing procedures in place at the entrance of the facility (aOR 0.81, 95% CI 0.10 to 6.34).

Mask and PPE usage

Four observational studies provided evidence on the effects of mask and PPE usage (Lipsitz 2020; Reyné 2020; Rolland 2020; Telford 2021), with one observational study providing evidence on modifying variables for the outcome domains of number of infections and probability of outbreaks (Shallcross 2021).

Evidence from multiple assessments in three studies (Lipsitz 2020; Reyné 2020; Telford 2021), suggests that the measure may reduce the number of infections, and evidence from one study (Rolland 2020), suggests that it may increase the probability of outbreaks, but for both outcomes the evidence is very uncertain (very low-certainty evidence). Evidence from one study (Lipsitz 2020), suggests that the measure may reduce the number of deaths, but the evidence for this is also very uncertain (very low-certainty-evidence).

Lipsitz 2020 reported on mask usage in the context of ongoing outbreaks in the facility. It assessed the weekly infection rate in those long-term care facilities which had implemented mask and PPE usage among staff caring for residents if there were COVID-19 cases identified in the facility compared with those facilities without the measure. It showed a clear effect favouring the measure: long-term care facilities with the measure showed a lower weekly infection rate (−0.23 cases per 100 residents and staff, 95% CI −0.45 to −0.01) and increased odds of reporting zero cases per week (aOR 2.16, 95% CI 1.42 to 3.30).

Reyné 2020 showed a clear effect in favour of the measure. Here, earlier implementation of generalised mask wearing by staff in an outbreak was associated with a lower number of cases (increase in the proportion of infected residents for each day of delay in mandatory mask wearing within the long-term care facilities: 0.55 percentage points; standard error (SE) 0.19 percentage points).

In Telford 2021, one assessment showed a clear and one assessment an unclear effect in favour of correct and proper usage of masks: 5 out of 11 long-term care facilities with a higher number of infections (prevalence of ≥ 39%), and 13 out of 13 long-term care facilities with a lower number of infections (prevalence of < 39%) in outbreaks reported the correct and proper use of masks by staff inside their COVID-19 unit (OR 0.03, 95% CI 0.00 to 0.66). Seven out of 11 long-term care facilities with a high prevalence of COVID-19 cases, and 12 out of 13 long-term care facilities with a low prevalence of cases reported correct and proper use of masks by staff outside the COVID unit (OR 0.15, 95% CI 0.01 to 1.58). The study also reported on three assessments for training and audits to ensure proper mask and PPE usage by staff. One out of the three assessments showed a clear effect favouring the training measure (OR 0.10, 95% CI 0.01 to 0.73), and two assessments showed an unclear effect favouring the measure (OR 0.36, 95% CI 0.07 to 1.88 and OR 0.10, 95% CI 0.01 to 1.06).

One case-control study reported on the probability of outbreaks (Rolland 2020). It showed an unclear effect favouring the control. In the study, a total of 75 out of 94 long-term care facilities without COVID-19 cases (79.8%), and 24 out of 30 long-term care facilities with at least one COVID-19 case reported having implemented the measure (aOR 1.6, 95% CI 0.26 to 11.00).

One study reported on the number of deaths (Lipsitz 2020). It showed a clear effect and an unclear effect favouring mask and PPE usage in one assessment. The long-term care facilities with the measure showed a lower weekly mortality rate (−0.02 deaths per 100 residents and staff, 95% CI −0.21 to 0.17) and increased odds of reporting zero deaths per week (aOR 3.20, 95% CI 1.87 to 5.48).

One study contributed data on potential moderating variables (Shallcross 2021). It reported the outcomes of interest based on how PPE was used in the facility. Using PPE for “any contact with infected or shielding residents” showed the lowest proportion regarding the number of infections among residents and staff, as well as the probability of large outbreaks (≥ 20 cases), compared with other uses of PPE (e.g. only when delivering direct care). Using PPE for “any contact with all residents” showed the lowest probability of an outbreak of any size (≥ 1 case), compared with the other uses of PPE.

Cohorting residents and staff

One observational study provided evidence on the effect of compartmentalising residents and staff in specific areas within the facility (Rolland 2020), and one modelling study contributed evidence on a specific form of compartmentalisation: immunity-based cohorting (Holmdahl 2021).

Evidence from the one modelling study (Holmdahl 2021), suggests that the measure may reduce the number of infections, although the evidence for this is very uncertain (very low-certainty evidence), while the evidence based on the observational study (Rolland 2020), is also very uncertain about the measure increasing or decreasing the probability of outbreaks (very low-certainty evidence).

The observational study Rolland 2020 showed mixed effects regarding the probability of outbreaks: in the assessment of the cohorting of residents, it showed a clear effect favouring the measure; in the assessment of cohorting of staff, it showed an

unclear effect favouring the control. In Rolland 2020, 65 out of the 94 long-term care facilities without COVID-19 cases (69.1%), and 9 out of the 30 long-term care facilities with at least one COVID-19 case reported to have implemented the measure of compartmentalising residents (aOR 0.17, 95% CI 0.04 to 0.67). The measure of compartmentalising staff into specific zones was implemented in 17 out of the 94 long-term care facilities without COVID-19 cases (18%), and four out of the 30 long-term care facilities with at least one COVID-19 case reported to have implemented the measure (aOR 3.01, 95% CI 0.51 to 18.51).

The modelling study assessed the effect of immunity-based cohorting of residents (i.e. assigning residents who are no longer susceptible after having acquired and survived SARS-CoV-2 infections as roommates of residents, who are still susceptible; Holmdahl 2021). The study showed an unclear effect favouring the measure regarding the number of infections among residents and regarding infections among staff. Holmdahl 2021 predicted a cumulative incidence of 67% among residents and 35% among staff members in a scenario of no measure. In the scenario with the measure, the cumulative incidence was predicted as 64% among residents and 31% among staff members.

Multicomponent contact-regulating and transmission-reducing measures in the context of vaccination

One modelling study (Love 2021), with 'critical concerns' for quality, compared a scenario of higher adherence to contact and transmission control measures compared with lower adherence, in the context of all facility residents and staff being fully vaccinated on the number of infections, hospitalisations, and deaths among residents and staff. The study showed clear effects favouring higher adherence to the contact-regulating and transmission-reducing measures for the number of infections, hospitalisations, and deaths.

Multicomponent contact-regulating and transmission-reducing measures

One observational study provided evidence on the effect of multicomponent contact-regulating and transmission-reducing measures Rolland 2020. This evidence suggests that the measure may reduce the probability of outbreaks, but the evidence is very uncertain (very low-certainty evidence).

Rolland 2020 compared long-term care facilities reporting a higher level of adherence to the measure based on a self-assessment quality scale compared with long-term care facilities that reported a lower score. The study showed a clear effect favouring higher levels of adherence for the probability of outbreaks. The case-control study with 94 long-term care facilities without COVID-19 cases and 30 long-term care facilities with at least one COVID-19 case showed reduced odds of having at least one COVID-19 case in long-term care facilities with a higher 'quality' score (aOR 0.55, 95% CI 0.33 to 0.93).

Surveillance measures

We included seven modelling studies (Delaunay 2020; Holmdahl 2021; Nguyen 2020; See 2020; Smith 2020a; Tsoungui 2021; Vilches 2020), and two observational studies (Telford 2020; Telford 2021), that contributed evidence on the effects of surveillance measures. They are depicted in the effect direction plots in Figure 7. A study-by-study overview of the evidence contributing to the outcomes in this intervention domain is presented in Appendix 12.

Figure 7. Direction of effects plot for intervention domain 3: surveillance measures

3. Surveillance measures														
Study ID	Study design	I. Infections			II. Contaminations	III. Outbreaks	IV. Hospitalisations			V. Deaths			VI. AE
		Res.	Staff	Res. & Staff			Res.	Staff	Res. & Staff	Res.	Staff	Res. & Staff	Res.
Intervention category 1. Routine testing of residents and staff independent of symptom status													
Telford 2020	OBS	▲	▲				▲	▲		▲	▼		
Holmdahl	MMS	▲	▲										
Nguyen 2020	MMS	▲											
Smith 2020a	MMS			▲		▲							
Vilches 2020	MMS	▲	▲				▲	▲		▲	▲		
Intervention category 2. Symptom-based surveillance testing													
Telford 2021	OBS			▲									
Smith 2020a	MMS			▲		▲							

▲: Direction of effect in favour of the measure; ▼: direction of effect in favour of the control; ●: null effect
AE: adverse effects; **MMS**: mathematical modelling study; **OBS**: observational study; **Res.**: residents

Routine testing of residents and staff independent of symptom status

One observational study (Telford 2020) and six modelling studies (Holmdahl 2021; Nguyen 2020; See 2020; Smith 2020a; Tsoungui 2021; Vilches 2020), provided evidence on the effect of surveillance testing (i.e. routine testing of residents or staff independent of symptoms) compared with no surveillance testing. In the modelling studies, the comparison focuses on the most conservative scenario of surveillance testing reported in the modelling studies (i.e. the lowest rate of testing, followed by the longest turnaround time and

the lowest sensitivity). We excluded two modelling studies (See 2020; Tsoungui 2021), with 'critical concerns' for quality, from the evidence synthesis.

Evidence from one observational study (Telford 2020) and from four modelling studies (Holmdahl 2021; Nguyen 2020; Smith 2020a; Vilches 2020), suggests that the measure may reduce the number of infections (low-certainty evidence). Evidence from one modelling study (Smith 2020a), suggests that the measure may reduce the probability of outbreaks, but the evidence is very uncertain (very low-certainty evidence). Evidence based on one observational study (Telford 2020), suggests that the measure may reduce hospitalisations (low-certainty evidence), while the evidence from one modelling study (Vilches 2020), suggests that the measure probably reduces hospitalisations (moderate-certainty evidence). While the evidence based on one observational study (Telford 2020), is very uncertain about whether the measure increases or decreases the number of deaths (very low-certainty evidence), evidence from one modelling study (Vilches 2020), suggests that the measure may reduce the number of deaths (low-certainty evidence).

The observational study Telford 2020 compared 13 long-term care facilities in which pre-emptive PCR-based testing was conducted in the absence of known cases in the facility (intervention group) with 15 long-term care facilities in which generalised PCR-based testing was conducted in response to an outbreak (control group). This analysis focuses on those facilities in the intervention group, in which cases were detected (in 8 out of the 13 long-term care facilities in the intervention group, at least one case of COVID-19 was detected). The study showed a clear effect favouring the intervention on the number of infections among residents, infections among staff, the number of hospitalisations among residents, and the number of hospitalisations among staff. The study showed mixed effects regarding the number of deaths: it showed a clear effect favouring the measure regarding the number of deaths among residents and a clear effect favouring the control for the number of deaths among staff.
The median hospitalisation rate was 7.4% among residents in the control group facilities (range: 2.0% to 27.0%) and 0% among residents in the intervention group facilities (range: 0.0% to 15.4%). Among staff, it was 0% in the control group facilities (range: 7.4% to 0%) and 0% in the intervention group facilities (range: 1.0% to 0%). The median mortality rate was 5.3% among residents in control group facilities (range: 0.9% to 23.8%) and 0% in intervention group facilities (range: 0% to 11.5%) among staff. None of the 15 facilities in the control group registered a death among staff, while one facility in the intervention group registered one death.

Four modelling studies showed effects favouring the measure: for the outcome domain number of infections, three modelling studies reported a clear effect (Holmdahl 2021; Nguyen 2020; Vilches 2020), and one study an unclear effect favouring the measure (Smith 2020a). One modelling study predicted an unclear effect favouring the measure for the probability of outbreaks (Smith 2020a). One modelling study predicted a clear effect favouring the measure for the number of hospitalisations among residents, number of hospitalisations among staff, and deaths among residents and unclear effects favouring the measure for number of deaths among staff (Vilches 2020). We assessed one study as having 'critical concerns' regarding parameter and structural assumption and we therefore excluded it from the evidence synthesis (See 2020).

The agent-based model SEIR Holmdahl 2021 predicted a reduction by 7.3 and 10.6 percentage points in the cumulative incidence rate among residents and among staff, respectively, compared with no testing after a follow-up time of three months (Holmdahl 2021).

In Nguyen 2020, the most conservative scenario in the agent-based SEIR model predicted a lower median rate of infections among residents (31 infections among 80 residents) after a follow-up period of three months. This was significantly lower (P value < 0.001) than in the scenario without testing (53 infections).

In Smith 2020a, a scenario simulated the availability of 16 PCR tests for 420 residents and staff per day. In the control scenario, these tests were predicted to be used to conduct a daily PCR-based testing of all residents and staff with COVID-19-like symptoms (approximately four to five tests per day). For this scenario, the model predicted that the median number of cases upon detection of an outbreak (i.e. one individual in the facility testing positive) would be 7 (95% interval: 1 to 33). In the scenario in which the remaining tests were used to conduct surveillance testing of a random sample of residents and staff, the median number of cases upon detection of an outbreak was lower (5 cases, 95% interval: 1 to 29).

In Vilches 2020, the scenario with the most conservative assumptions about surveillance testing predicted 25.9% (95% CrI 23.3% to 28.3%) and 25.3% (95% CrI 22.6% to 28.1%) relative reductions in infections among residents and staff compared to no intervention, respectively, for a follow-up period of 200 days.

We excluded the model proposed by See 2020 from the analysis due to concerns in study quality. In this study, scenarios with less conservative assumptions about the test characteristics predicted an effect in the same direction of the effect than for the most conservative scenario (i.e. favouring the intervention).

In general, across all five studies, less conservative scenarios predicted effects in the same direction.

One modelling study reported on the probability of outbreaks and predicted an unclear effect favouring the measure (Smith 2020a). Daily PCR testing of pooled samples (i.e. conducting one PCR test on a pooled set of multiple samples) predicted a higher detection rate of outbreaks (i.e. one individual testing positive for SARS-CoV-2) prior to a secondary case in the facility (11% of simulations), compared with the scenario in which residents and staff were tested only when they predicted severe COVID-19-like symptoms (4%).

One study reported on the number and proportion of hospitalisations and predicted a clear effect favouring the measure (Vilches 2020). The number of hospitalisations among residents and staff was lower in all scenarios with weekly PCR-based testing compared with no testing. Furthermore, the study predicted lower rates of hospitalisations in scenarios with shorter (24-hour) versus longer (48-hour) turnaround time, as well as in those with higher versus lower test sensitivity. For example, PCR-based testing with a turnaround time of 24 hours predicted 38.6% (CrI 31.9% to 45.0%) and 28.4% (95% CrI 23.0% to 36.8%) reductions in the number of hospitalisations with higher and lower test sensitivity, respectively. For PCR-based testing with a turnaround time of 48 hours, the reductions were 25.3% (CrI 17.2% to 31.9%) and 26.2% (95% CrI 16.9% to 33.8%) with higher and lower test sensitivity, respectively.

Two studies reported on the number and proportion of deaths among residents (Tsoungui 2021; Vilches 2020), and among staff (Vilches 2020), one of which was rated as 'critical concerns' for quality (Tsoungui 2021). Vilches 2020 showed a clear effect favouring the measure regarding the number of deaths among residents and an unclear effect favouring the measure for the number of deaths among staff in all scenarios with weekly PCR-based testing compared with no testing. Tsoungui 2021, which we excluded from the analysis, predicted the same direction of effect across all scenarios.

Vilches 2020 predicted lower mortality rates among residents and staff when comparing scenarios with shorter (24-hour) versus longer (48-hour) turnaround times, as well as with higher versus lower test sensitivity. Tsoungui 2021 predicted effects in the same direction. For example, PCR-based testing with a turnaround time of 24 hours predicted 24.4% (95% CrI 0.01% to 43.3%) and 20.5% (95% CrI to 0.04% to 37.7%) reductions in deaths for the scenarios with higher and lower test sensitivity, respectively (Vilches 2020). PCR-based testing with a turnaround time of 48 hours predicted 45.4% (CrI 24.4% to 59.9%) and 28.8% (95% CrI 0.1% to 46.4%) reductions in the number of deaths for the scenarios with higher and lower test sensitivity, respectively (Vilches 2020).

Seven studies reported multiple scenarios, allowing for an analysis of potential variables that could explain the variation in the magnitudes of effect (Delaunay 2020; Holmdahl 2021; Nguyen 2020; Smith 2020a; See 2020; Tsoungui 2021; Vilches 2020).

Six modelling studies examined scenarios with *different rates of testing* (Delaunay 2020; Holmdahl 2021; Nguyen 2020; Smith 2020a; See 2020; Tsoungui 2021), with three studies with critical concerns for quality (Delaunay 2020; See 2020; Tsoungui 2021). In all six studies, a dose-response-effect was predicted, with higher rates of testing being more effective in reducing the number of infections compared with lower rates of testing with the most effective scenario being the one with the highest rate of testing. For example, in Holmdahl 2021, the scenario of testing residents and staff once per week predicted a higher mean for cumulative incidence among residents across the iterations of the model (mean: 26%; SD: 6%) at three months' follow-up. Testing at higher rates of testing every three days (mean: 11%; SD: 3%) and every day (mean: 7%; SD: 2%) predicted lower rates of infections.

Five studies examined scenarios with *different levels of test sensitivity* (Delaunay 2020; See 2020; Smith 2020a; Tsoungui 2021; Vilches 2020) and two studies *with different turnaround times for PCR-based testing* (See 2020; Tsoungui 2021; Vilches 2020). We assessed three of the studies as having critical quality concerns (Delaunay 2020; See 2020; Tsoungui 2021). In all of these studies, scenarios with higher test sensitivity and lower turnaround time predicted reductions in the number of infections compared with scenarios with lower test sensitivity and longer turnaround time, respectively. For example, in the study Vilches 2020 , in the scenarios with PCR-based testing with a turnaround time of 24 hours, the number of infections was reduced by 42.1%; (95% CrI 40.3% to 43.9%) in the scenario with higher test sensitivity and by 34.3% (95% CrI 32.2% to 36.2%) in the scenario with lower test sensitivity. For the scenarios with a turnaround time of 48 hours, the number of infections was reduced by 30.3% (95% CrI 28.4 to 32.3%) in the scenario with higher test sensitivity and by 25.9% (95% CrI 23.3% to 28.3%) in the scenario with lower test sensitivity.

Three studies examined scenarios with *different types of tests*, such as PCR-based or antigen-based tests (Holmdahl 2021; See 2020; Tsoungui 2021), including two studies with 'critical concerns' regarding quality (See 2020; Tsoungui 2021). In Holmdahl 2021, the scenarios in which residents and staff were tested with PCR-based tests with a turnaround time of 48 hours predicted a higher cumulative incidence among residents after three months compared with testing with antigen-based tests at the same rate (with immediate turnaround time) but a lower assumed limit of detection. For testing once per week, the mean cumulative number of infected residents was 17%, SD 6% for PCR-based testing, and 12%, SD 4% for antigen-based testing. See 2020 predicted mixed effects, with results depending on the assumed relative difference in the sensitivity of the antigen-based tests and the assumptions about turnaround time of the test results.

Three studies examined scenarios comparing testing of *different groups within the facility population*. Two studies examined scenarios in which residents and staff were tested against those in which only residents were tested (Nguyen 2020; Smith 2020a), and three studies examined the testing of residents and staff against testing staff only (Holmdahl 2021; Nguyen 2020; Smith 2020a). All scenarios favoured conducting surveillance testing of residents and staff, over conducting surveillance testing with only one of the subgroups. For example, the mean cumulative number of infections among residents across the 100 iterations of the model was 53 per 80 residents after 90 days without testing. The scenario in which residents and staff are tested predicted a mean number of 31 infections among residents, the scenario in which only staff are tested predicted a mean of 32 infections, and the scenario in which only residents are tested predicted a mean of 53 infections (Nguyen 2020).

Symptom-based surveillance

One observational study and one modelling study provided evidence on the effects of symptom-based surveillance (Smith 2020a; Telford 2021). The evidence from both of these studies suggests that the measure may reduce the number of infections. The evidence based on one modelling study suggests that the measure may reduce the probability of outbreaks but the evidence is very uncertain in all of these cases (very low-certainty evidence; Smith 2020a).

Telford 2021 showed an unclear effect favouring the measure regarding the overall number of infections in outbreaks. In the case-control study, 3 out of the 11 long-term care facilities with a high prevalence of SARS-CoV-2 (≥ 39% infection prevalence), and 8 out of the 13 long-term care facilities with a low prevalence of SARS-CoV-2 (≤ 39% infection prevalence), reported having implemented a symptom-based surveillance measure. The measure consisted of regular screening of temperature and symptoms among residents and staff and keeping and analysing logs for daily trends. The implementation of this measure was associated with reductions in the odds of having a high-prevalence outbreak (OR 0.23, 95% CI 0.04 to 1.33).

The modelling study Smith 2020a assessed symptom-based surveillance testing (i.e. testing of residents or staff with COVID-19-like symptoms for SARS-CoV-2). It showed an unclear effect favouring the measure regarding the number of infections and the probability of outbreaks. In the model, the median number of infections among residents upon detection of an outbreak

was higher in the scenario in which only individuals with severe COVID-19-like symptoms are tested (median: 26 cases per 410 residents and staff, 95% interval: 1 to 116) compared with the scenario in which all individuals with any COVID-19-like symptoms are tested (median: 7 cases per 410 residents and staff members, 95% interval: 1 to 35). The same direction of effect was observed for the proportion of iterations with a detection of an outbreak prior to a secondary case in the facility (4% in the scenario of testing individuals with severe COVID-19-like symptoms only versus 15% for testing all individuals with any COVID-19 like symptom).

Outbreak control measures

Four observational studies (Lipsitz 2020; Lombardo 2021; Shallcross 2021; Telford 2021), and three modelling studies (Holmdahl 2021; See 2020; Wilmink 2020), provided evidence on outbreak control measures. Due to critical quality concerns, we excluded two modelling studies from the evidence synthesis: See 2020, which provided evidence on generalised outbreak response testing; and Wilmink 2020, which provided evidence on digital contact tracing. These studies are depicted in the effect direction plots in Figure 8. A study-by-study overview of the evidence contributing to the outcomes in this intervention domain is presented in Appendix 13.

Figure 8. Direction of effects plot for intervention domain 4: outbreak control measures

4. Outbreak control measures													
Study ID	Study design	I. Infections			II. Contaminations	III. Outbreaks	IV. Hospitalisations			V. Deaths			VI. AE
		Res.	Staff	Res. & Staff			Res.	Staff	Res. & Staff	Res.	Staff	Res. & Staff	Res.
Intervention category 1. Separating infected and non-infected residents or staff caring for infected and non-infected residents													
Lipsitz 2020	OBS			▲▲								▲▲	
Shallcross 2021	OBS	▲	▲	▼		▲							
Telford 2021	OBS			▲▲▲									
Holmdahl 2020	MMS	▲	▲										
Intervention category 2. Isolation of cases													
Lombardo 2020	OBS					▲							
Shallcross 2021	OBS	▲	▲	▲		▲							

▲: Direction of effect in favour of the measure; ▼: direction of effect in favour of the control; ●: null effect
AE: adverse effects; **MMS**: mathematical modelling study; **OBS**: observational study; **Res.:** residents

Separating infected and non-infected residents or staff caring for infected and non-infected residents

Three observational studies (Lipsitz 2020; Shallcross 2021; Telford 2021), provided evidence on the effect of separating residents who are known or suspected to be infected with SARS-CoV-2 from those who are not (e.g. in dedicated wings, wards or units). One modelling study (Holmdahl 2021), assessed the effect of immunity-based staffing (i.e. assigning staff members who are immune to SARS-CoV-2 infections to the non-COVID-19 units and vice versa).

The evidence based on three observational studies (Lipsitz 2020; Shallcross 2021; Telford 2021), suggests that the measure may reduce the number of infections, but the evidence is very uncertain (very low-certainty evidence). Evidence from one modelling study suggests that the measure may reduce the number of infections, but the evidence is very uncertain (very low-certainty evidence; Holmdahl 2021). Evidence based on one observational study (Shallcross 2021), suggests that the measure may reduce the probability of outbreaks (low-certainty evidence). Based on one observational study (Lipsitz 2020), the evidence suggests that the measure may reduce the number of deaths, but the evidence is very uncertain (very low-certainty evidence).

Regarding the number of infections, one observational study (Lipsitz 2020), showed a clear effect in favour of the measure in two assessments, one study (Telford 2021), showed a clear effect in one assessment and an unclear effect in favour of the measure in two assessments. One study showed a clear effect in favour of the measure in two assessments and an unclear effect in favour of the control in one assessment (Shallcross 2021).

One observational study (Lipsitz 2020), assessed the effects of separating residents who are either confirmed (through testing) to be infected or recovering from COVID-19, from residents who are not infected and have unknown status, as part of a multicomponent outbreak response measure. In the assessment, long-term care facilities that had implemented the measure reported a lower weekly infection rate (−0.5 cases per 100 residents and staff, 95% CI −0.84 to −0.16) and increased odds of reporting zero cases per week (aOR 3.00, 95% CI 1.34 to 6.71). Furthermore, facilities with the measure showed lower weekly mortality rates (−0.38 deaths per 100 residents and staff, 95% CI −0.75 to 0.00) and increased odds of reporting zero deaths per week (aOR 1.98, 95% CI 0.58 to 6.75).

The observational study Shallcross 2021 compared SARS-CoV-2-related outcomes in long-term care facilities that reported that members of staff were often or always cohorted with either infected or uninfected residents with those facilities that reported that this was not at all the case. The ratio of infected to uninfected residents and staff was lower in the facilities with the measure (3112 out of 30,330 residents (10.3%) and 1653 out of 43,123 staff (3.8%)) compared with those without the measure (4458 out of 25,950

residents (17.2%) and 2471 out of 38,870 staff (6.4%); aOR 0.83, 95% CI 0.78 to 0.88). Long-term care facilities with the measure reported outbreaks at a lower rate (470 out of 829 facilities (56.7%)) compared with the facilities without the measure (580 out of 692 facilities (83.8%); aOR 0.38, 95% CI 0.29 to 0.52). Regarding large outbreaks (≥ 20 cases), long-term care facilities with the measure reported a lower rate (74 out of 470 facilities (15.7%)) compared with the facilities without the measure (104 out of 580 facilities (17.9%)); however, the adjusted odds ratio showed an unclear effect favouring the control (aOR 1.02, 95% CI 0.79 to 1.42).

In the case-control study Telford 2021, 9 out of 11 long-term care facilities with a high prevalence of SARS-CoV-2 in an outbreak (≥ 39% infection prevalence), and 11 out of 13 long-term care facilities with a low prevalence of SARS-CoV-2 (≤ 39% infection prevalence) reported having residents in a COVID-19 unit or an observation area physically separated from the COVID-19-negative residents (OR 0.82, 95% CI 0.10 to 7.02). Furthermore, it reported that facilities with a lower prevalence of SARS-CoV-2 cases in an outbreak were more likely to have implemented droplet and contact precaution signage outside of a COVID-19 unit and individual rooms of COVID-19-positive residents, compared with facilities with higher prevalence outbreaks (OR 0.11, 95% CI 0.02 to 0.72).

Isolation of cases

Two observational studies compared SARS-CoV-2-related outcomes in long-term care facilities with the inability to isolate or those reporting problems in isolating infected residents, which was used as a proxy control (Lombardo 2021; Shallcross 2021). The inability to isolate or problems implementing isolation could result from non-adherence to the measure by the residents (e.g. due to dementia) or from structural problems of the facility.

Evidence based on one observational study (Shallcross 2021), suggests that the measure may reduce the number of infections, and evidence based on two studies (Lombardo 2021; Shallcross 2021) suggests that it may reduce the probability of outbreaks, but the evidence is very uncertain in both cases (very low-certainty evidence).

One study (Shallcross 2021), showed a clear effect favouring the measure for the number of infections among residents (aOR 0.75, 95% CI 0.72 to 0.78), infections among staff (aOR 0.68, 95% CI 0.64 to 0.71), and probability of a large outbreak (≥ 20 cases; aOR 0.62, 95% CI 0.47 to 0.81). The study furthermore demonstrated that long-term care facilities that were unable to isolate cases reported a higher rate of outbreaks of any size (846 out of 1077 facilities (78.6%)) compared to the facilities that did not report the inability to isolate residents (1035 out of 2052 facilities (50.4%); aOR 1.84, 95% CI 1.48 to 2.30).

The observational study Lombardo 2021, which was based on a survey of 1356 long-term care facilities, showed a clear effect in favour of the measure regarding the probability of outbreaks. Here, those long-term care facilities reporting problems in isolating infected residents were more likely to report a COVID-19 outbreak compared to facilities not reporting issues in isolating residents (aOR 1.97, 95% CI 1.42 to 2.73).

Generalised outbreak response testing

One modelling study, which we excluded from the main analysis due to critical quality concerns, reported on the number of infections. Across all scenarios, the number of infections per outbreak was lower when generalised outbreak testing was conducted compared with the scenario with symptom-based testing only (See 2020). Scenarios with higher rates of testing, shorter turnaround time for PCR tests, and higher test sensitivity predicted a higher proportion of prevented cases.

Multicomponent measures across multiple intervention domains

Two observational studies (Lipsitz 2020; Vijh 2021), and one modelling study (Nguyen 2020), assessed the effect of multicomponent measures, which include multiple entry regulation, contact-regulating and transmission-reducing, surveillance, and outbreak control measures. These are depicted in the effect direction plots in Figure 9. A study-by-study overview of the evidence contributing to the outcomes in this intervention domain is presented in Appendix 14.

Figure 9. Direction of effects plot for intervention domain 5: multicomponent measures across multiple intervention domains

5. Multicomponent measures across multiple intervention domains														
Study ID	Study design	I. Infections			II. Contaminations	III. Outbreaks	IV. Hospitalisations			V. Deaths			VI. AE
		Res.	Staff	Res. & Staff			Res.	Staff	Res. & Staff	Res.	Staff	Res. & Staff	Res.
Intervention category 1. Multicomponent measures, including entry regulation, transmission and contact control, surveillance, and outbreak control measures													
Lipsitz 2020	OBS			▲▲								▲▲	
Vijh 2021	OBS	▲	▲										
Nguyen 2020	MMS	▲											

▲: Direction of effect in favour of the measure; ▼: direction of effect in favour of the control; ●: null effect
AE: adverse effects; **MMS**: mathematical modelling study; **OBS**: observational study; **Res.**: residents

Multicomponent measures including entry regulation, contact-regulating and transmission-reducing, surveillance, and outbreak control measures

Two observational studies (Lipsitz 2020 ; Vijh 2021), and one modelling study (Nguyen 2020), provided evidence on the effect of multicomponent outbreak response measures. All studies reported on the effect of implementing a broad set of measures (including quarantine and isolation of suspected cases, and generalised outbreak response testing) following the interventions in facilities with an ongoing outbreak.

Both the evidence from two observational studies and one modelling study suggest that the measure may reduce the number of infections (low-certainty evidence). Based on one observational study, the evidence suggests that the measure may reduce the number of deaths, but the evidence for this is very uncertain (very low-certainty evidence).

Both observational studies showed a clear effect favouring the measure for the number of infections. One study with two assessments showed a clear effect and an unclear effect favouring the measure in one assessment, respectively (Lipsitz 2020 ; Vijh 2021).

The ITS Vijh 2021 assessed the average daily change in the rate of COVID-19 during the post-intervention period (starting 14 days after the intervention) relative to the pre-intervention period. It found a significant trend change for the number of infections among residents (rate ratio: 0.72, 95% CI 0.65 to 0.80; p-value: <0.0001) and staff (rate ratio: 0.77, 95% CI 0.65 to 0.90; p-value: <0.01) after the implementation of the measure.

The observational study Lipsitz 2020, assessed the effects of a combination of measures to increase implementation and adherence to multiple transmission and contact reduction measures, as well as surveillance and outbreak control measures. In the assessment, outcomes were compared between long-term care facilities with a higher score on the number of items in a 28-item infection control competency checklist, reflecting the number of measures implemented in the facility, and long-term care facilities with a lower score. The study found a decrease in the weekly infection (−0.8 cases per 100 residents and staff, 95% CI −0.12 to −0.03) and mortality rates (−0.03 cases per 100 residents and staff, 95% CI −0.09 to 0.02) per additional item implemented on the 28-item infection control competency checklist. Furthermore, long-term care facilities with a higher score were more likely to report zero infections per week (aOR 1.13, 95% CI 1.04 to 1.23) and zero deaths per week (aOR 1.16, 95% CI 1.06 to 1.27).

One modelling study provided evidence on the effect of multicomponent measures, including double testing of new admissions, isolation of symptomatic cases, social distancing measures and visiting restrictions (Nguyen 2020). It predicted a clear effect favouring the measure regarding the number of infections among residents.
The mean cumulative number of infections among residents was higher in the scenario without any entry, contact-regulation, and transmission-reducing measures (mean number of infections: 74 per 80 residents) compared with the scenario with these measures in place (mean number of infections: 53).

DISCUSSION

Discussion

Summary of main findings

This review sought to identify and synthesise the evidence on the effectiveness of non-pharmacological interventions for the prevention of SARS-CoV-2 infections in long-term care facilities. In all, we identified 22 unique studies (11 observational and 11 modelling) that assessed the effects of entry regulations, contact-regulati o n and transmission-reduc t i o n measures, surveillance measures, and outbreak control measures on SARS-CoV-2 transmission, COVID-19 morbidity and mortality, and (to a lesser extent) adverse effects of these prevention measures.

We identified four observational studies (Belmin 2020; McArthur 2021; Shallcross 2021; Telford 2021), and four modelling studies (Knock 2021; Nguyen 2020; Smith 2020a; Smith 2020b), that provided evidence on a range of entry regulation measures designed to prevent the introduction of SARS-CoV-2 into long-term care facilities. The evidence in this domain, which we judged to be of low to very low certainty using GRADE (GRADE 2013), suggests that the implementation of certain entry regulation measures, including self-confinement of residents (Belmin 2020), mandatory quarantine for new admissions (Nguyen 2020; Shallcross 2021; Telford 2021), and admission restrictions for residents and visitors (Knock 2021; McArthur 2021; Shallcross 2021), may be beneficial across multiple outcomes, namely the number of infections and deaths, and the probability of contamination, that is, at least one infection introduced to or identified in the facility, although the effect is uncertain.

We identified six observational studies (Green 2021; Lipsitz 2020; Reyné 2020; Rolland 2020; Shallcross 2021; Telford 2021), and two modelling studies (Holmdahl 2021; Love 2021), on the effectiveness of various contact -regulation and transmission -reducing measures designed to reduce the frequency of contacts and to increase the safety of interactions between people within long-term care facilities, primarily among residents, and between staff and residents. The evidence in this domain, which we assessed to be of low to very low certainty, suggests that the implementation of certain contact-regulation and transmission-reducing measures, which included barrier nursing, cleaning measures, PPE use, and cohorting of residents and staff, can have beneficial effects, though findings were mostly mixed or unclear. Of particular note, the use of masks and PPE was found to clearly reduce the number of infections and deaths due to COVID-19.

We identified two observational studies (Telford 2020; Telford 2021), and six modelling studies (Holmdahl 2021; Nguyen 2020; See 2020; Smith 2020a; Tsoungui 2021; Vilches 2020), on the effectiveness of surveillance measures designed to identify SARS-CoV-2 infections within long-term care facilities. Most of the modelling studies focused on predicting the effects of testing regimes with various combinations of features and parameters, namely test types (PCR versus antigen), testing rates, sensitivity levels, and turnaround times. The evidence in this domain, which we assessed to be of moderate to very low certainty, suggests that the implementation of routine surveillance testing independent of symptoms has a beneficial effect on the number of infections and hospitalisations among residents and staff, although the effect is uncertain.

We identified four observational studies (Lipsitz 2020; Lombardo 2021; Shallcross 2021; Telford 2021), and three modelling studies (Holmdahl 2021; Wilmink 2020; See 2020) — the latter two of which were excluded due to critical risk of bias — on outbreak control measures designed to prevent secondary infections and limit the spread and severity of existing outbreaks in long-term care facilities. The evidence in this domain, which we assessed to be of low to very low certainty, suggests a reduction in the number of infections and the probability of outbreaks when infected cases were isolated or separated from non-infected residents.

Finally, we identified two observational studies (Lipsitz 2020; Vijh 2021), and one modelling study (Nguyen 2020), on the effectiveness of combinations of measures across the intervention domains. The evidence in this domain, which we assessed to be of low to very low certainty, suggests a clear reduction in numbers of infections and deaths.

Overall completeness and applicability of the evidence

The 22 studies included in this review addressed the effects of a range of COVID-19 prevention and control measures across all five intervention domains as well as adverse effects. Still, we identified significant gaps in this literature, especially in relation to the settings, populations, and interventions studied, and the outcomes assessed across intervention categories.

During the ongoing pandemic, scientific evidence in this area, like all research on COVID-19, is rapidly expanding, and additional studies have been published since we conducted our database searches. Therefore, the generated evidence is limited. We anticipate that future updates and an extended scope of review will capture an evidence base that is more comprehensive and that accounts for recent developments (e.g. vaccine distribution).

We are aware of 10 of such studies (Ehrlich 2021; Fosdick 2021; Gómez-Vázquez 2021; Hua 2021; Kahn 2021; Roselló 2021; Schmidt 2021; Stall 2021; Stevenson 2021; Tulloch 2021). These include two observational studies (Ehrlich 2021; Tulloch 2021) and six modelling studies (Fosdick 2021; Gómez-Vázquez 2021; Kahn 2021; Roselló 2021; Schmidt 2021; Stevenson 2021), which assessed or predicted the effect of the surveillance measures. All but one study (Tulloch 2021), reported effects favouring the measures on COVID-19 related outcomes. The observational study by Hua 2021 reported an increase in adverse mental health effects among residents for entry regulation as well as contact-regulation and transmission-reducing measures. The observational study Stall 2021 reported an increase in the prescription of psychotropic medication for residents following the implementation of multicomponent infection control measures. Based on a preliminary assessment, these studies do not appear inconsistent with the findings of this review. A critical full evaluation of these studies will be conducted in a future update of the review.

Population

While all included empirical studies seem to have focused on long-term care facilities with elderly residents, the characteristics of resident populations were not always adequately reported. Most studies did not report existing comorbidities and age structure of study samples, as well as other potentially relevant factors (e.g. mobility, quality of life, proportion of participants with disabilities, course of infection for older people). In particular, no study explicitly assessed residents of long-term care facilities who were living with disabilities. Furthermore, the studies did not allow a disaggregation of the effects by age, gender, or co-morbidity status.

Setting

Despite the detailed database searches and no limitations on the basis of geographic context, we mostly identified evidence from Canada, France, the UK and the USA, with very little evidence from outside of North America and Europe. Furthermore, all but one identified study, with critical risk of bias, did not assess outcomes in vaccinated residents and staff. This gap is a particular issue, as in most Western countries, high rates of vaccination have been achieved in long-term care facility populations at the time of database searches for this review, and the applicability of the evidence synthesised in this review for other world regions may be limited.

All the evidence synthesised in this review is related to the implementation of measures within long-term care facilities. However, long-term care facilities are not defined uniformly in the literature, and in the studies included in this review, they were often not clearly described to enable appropriate differentiation among types of long-term care facilities. For instance, no studies explicitly distinguished between 'residential care' and 'care homes', as well as other types of long-term care facility. This limits our ability to make nuanced conclusions regarding the effectiveness and implementation of the measures in these different types of long-term care facilities, which might vary across nations.

A large proportion of studies were conducted in 2020 during the early stages of the pandemic. In the later period of the pandemic, long-term care facilities and relevant stakeholders might have been better prepared to respond to the emergency, in part due to the roll-out of vaccinations. This may present a generalisability issue, as shortages of FFP2-masks and other PPE equipment in early phases of the pandemic may have had an influence on the estimates of effect and the transferability to situations and settings with fewer resource constraints.

Interventions

The presented evidence covers a diversity of measures across the five intervention domains. For most measures, we found only one study that contributed to the body of evidence, leading to low and very low certainty of evidence ratings. Real-world evidence of surveillance testing measures within long-term care facilities is lacking, therefore recommendations at this stage must rely on evidence from modelling studies. In particular, there is limited real-world evidence on the use of rapid testing in long-term care facilities.

Outcomes

The empirical studies which examined the impact of non-pharmacological measures within long-term care facilities assessed the impact of these measures primarily on SARS-CoV-2 infections, as well as mortality and contamination/outbreak outcomes. The modelling studies additionally generated evidence on hospitalisation outcomes.

Very little evidence was found on unintended and other adverse consequences (e.g. morbidity of mental illness, quality of life of LTCF residents, staff burnout due to increased workload, etc.). Evidence generated in this review can inform

recommendations regarding non-COVID-19 related outcomes, unintended consequences, and implementation outcomes only to a limited extent.

Study designs

The studies included in this review employed either observational design or mathematical modelling. Overall, most observational studies were case-control or cohort studies with serious risk of bias due to confounding. This limits the applicability of the evidence from observational studies, as association and causation may not always be clearly distinguished with these study designs. Similarly, the applicability of the evidence from modelling studies is limited, as assumptions employed in most models were assessed to be inadequate to reflect real-world practices and all models lacked an external validation.

Sources of heterogeneity

We did not assess heterogeneity as prespecified in the review protocol, as no body of evidence met our predefined conditions for such an assessment. However, when presenting the review findings, we documented sources of heterogeneity that could potentially explain the variation in the reported direction and magnitude of effects. These were primarily derived from modelling studies examining multiple implementation scenarios. The studies assessed the following factors:

- Entry regulations
  - Adherence and implementation timing: evidence indicated that implementing self-confinement of residents with staff in the absence of known cases in the facility and with higher adherence of staff could increase the effectiveness of the measure.
- Contact-regulation and transmission-reducing measures
  - PPE usage: this relates to the ways in which PPE is used in facilities. Using PPE for any contact with infected or shielding residents and for any contact with residents predicted better outcomes than other uses. In the case of an outbreak, earlier generalised usage of masks by staff was associated with a lower number of infections.
  - Contact-reduction measures: here, the studies showed mixed effects. However, the evidence is not sufficient to draw clear conclusions on effective and ineffective contact - reduction measures.
- Surveillance measures
  - Rate of testing and proportion of the population tested: evidence from included studies suggest that the rate of testing can play a role with higher rates of testing and testing larger shares of the population at the same frequency predicting larger effects. Across all modelling studies, the scenarios with the highest rate of testing were predicted to be most effective.
  - Test sensitivity: tests with high sensitivity predicted better outcomes.
  - Turnaround time of PCR-based testing: this relates to the time between testing and the availability of results, with low turnaround time predicting better outcomes.
  - Types of tests: at the same rate of testing, it is unclear whether PCR-based or antigen-based tests lead to better results. The effect likely depends on assumptions related to turnaround time and test sensitivity.
  - Facility populations being tested: surveillance testing of residents and staff predicted better outcomes than the testing of only one of those subgroups.
- Outbreak control measures
  - Separation of infected and non-infected residents or staff caring for infected and non-infected residents showed mixed effects. Here, separating infected and non-infected residents showed an effect favouring the measure, while separating staff members showed mixed effects due to a borderline effect in favour of the control.

Certainty of the evidence

The certainty of evidence was rated as moderate for only one outcome in the review (the number of hospitalisations for routine testing of residents and staff independent of symptom status), whereas it was rated as either low or very low for all the other outcomes. This suggests that the true effects may be substantially different from the estimates reported in this review (GRADE 2013; Hultcrantz 2017). The common reasons for downgrading the evidence included study design (the evidence from case-control and cross-sectional studies, which were not assessed with the ROBINS-I tool), risk of bias (for observational studies assessed with ROBINS-I) and quality (for modelling studies), inconsistency in the direction of effect, imprecision regarding the direction of effect, and indirectness.

Observational studies provided evidence on all the predefined intervention domains. All observational studies, except for one, that were assessed with the ROBINS-I tool, were judged to have serious risk of bias, notably due to major concerns in the 'bias due to confounding' domain for all but one of the included observational studies. For some of these studies, we also noted major concerns in the following domains: 'bias in selection of participants into the study', 'bias in classification of interventions', 'bias due to deviations from intended interventions', 'bias in measurement of outcomes', and 'bias in selection of the reported result'. All the case-control and cross-sectional studies that we assessed with the corresponding JBI Critical Appraisal Checklists were also judged to have serious risk of bias primarily due to major concerns with how studies accounted for potential confounders.

Modelling studies provided evidence on all intervention domains. We judged five modelling studies to have critical concerns with quality and therefore excluded those from the main analysis. We judged five modelling studies to have moderate concerns with quality, and one study to have major concerns. The lack of sufficient external validation across all studies prevented a quality rating of 'low concerns'. We downgraded the bodies of evidence comprising modelling studies for risk of bias because of moderate to major concerns regarding the parameter and structural assumptions of the models. In most cases, the concerns related to unreasonable or simplistic assumptions used to structure the models and insufficient justification for the choice of model parameters. These assumptions can limit the utility of the evidence from modelling studies.

We downgraded evidence for inconsistency whenever there were differences in the direction of the effect estimates in the body of evidence. We did not consider inconsistency in bodies of evidence comprising one contributing study. While we acknowledge that this approach might artificially inflate our certainty ratings in single-study bodies of evidence (compared to bodies of evidence

with multiple studies), there is as yet no established guidance addressing this issue in the application of GRADE.

We downgraded evidence for imprecision primarily when the confidence intervals for the effect estimates in a given body of evidence crossed the null effect (the pre-defined threshold of interest for this review), allowing the possibility of the real effect being either in the opposite direction or a null effect. The other reason for downgrading evidence for imprecision involved the insufficient assessment of the uncertainty in modelling studies, including uncertainty regarding structural or parameter assumptions and also stochastic uncertainty. Lack of consideration of the effect of the uncertainties limits our ability to adequately assess uncertainty of the provided effects and therefore the evidence from modelling studies.

When assessing indirectness, we employed two criteria to downgrade the certainty of the evidence. These included lack of external validation of the mathematical models (for the bodies of evidence comprising modelling studies) and indirectness in how the measure was conceptualised in the studies. The first creates uncertainties in assessing the applicability of the model outputs to real-world outcomes and thereby to our review question. The second creates uncertainties regarding the eligibility of the intervention for this review.

Potential biases in the review process

This review was conducted in a systematic, transparent, and reproducible manner according to the highest standards of rigor and following methods prescribed in the *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins 2021b), and the Cochrane guidance for rapid reviews (Garritty 2021; Garritty 2020). We described our review objectives and research questions, defined the scope of intervention and outcome categories of interest, and specified all planned review procedures a priori in a detailed review protocol, reviewed and approved by Cochrane Public Health and published in the Cochrane Library (New Reference). As such, this review is characterised by a number of strengths. Specifically, we used a comprehensive search strategy designed by an experienced information specialist and conducted searches in key general and COVID-19-specific databases. To comprehensively describe the growing evidence related to COVID-19, we considered a range of study designs and publication types, including modelling studies and preprints. We employed independent screening of all retrieved records and risk of bias or quality assessment of all included studies by two review authors to limit the influence of bias and human error. While this is a step that is often compromised in rapid reviews (Garritty 2020; Garritty 2021), we had sufficient team capacity to implement it according to the best practices for systematic reviewing. Furthermore, all extracted data were carefully checked by a second review author. We involved experts in modelling studies to assist with extraction, quality appraisal, and synthesis of the evidence from modelling studies, as these require specialist knowledge and skills. Finally, we held regular core author team meetings to discuss key analytical decisions, such as the classification of interventions and the judgements involved in conducting the GRADE assessment. Furthermore, this review provides a framework of intervention domains and categories, which was both derived from a systems-based and process-oriented logic model as well as from the empirical literature, and may provide a tool for researchers and practitioners intending to classify non-pharmacological measures implemented in long-term care facilities as well as those intending to conduct more robust studies to assess their effects on residents and staff.

Despite these strengths, our review has potential limitations that are worth noting. It is possible that our searches missed key records because of inadequate indexing in journals and preprint servers or because they were conducted in languages other than those considered in the review (e.g. studies published only in Chinese). We also did not comprehensively search the grey literature (e.g. websites of key organisations) except for preprint servers, which might have yielded reports providing additional detail on the implementation and potential adverse effects or unintended consequences of the measures implemented in long-term care facilities. However, conducting such searches would have entailed a much more extensive review process beyond the timeline required of a rapid review.

The development of policy recommendations during a rapidly-developing global emergency sometimes demands the use of modelling evidence when little observational or experimental data are available. While most of the identified evidence for this review came from observational studies, we also included several modelling studies. Our third intervention domain — in which we synthesised evidence on surveillance measures in long-term care facilities — depended exclusively on mathematical models. Because of the lack of validated methods to appraise the quality of these studies and to integrate them systematically, we had to use a bespoke quality appraisal tool that had been developed by the review authors as part of two other Cochrane rapid reviews (Burns 2021; Krishnaratne 2020). Both its initial development and its application in the present review were supported by modelling experts on our author team. We also encountered challenges applying the GRADE approach to rate the certainty of evidence from modelling studies. Unfortunately, the existing GRADE guidance does not operationalise the use of the GRADE domains for a body of evidence comprising more than one modelling study (Brozek 2021). For example, there is no guidance on how to define imprecision or indirectness in the context of modelling studies, when they use large numbers of parameters and scenarios reporting wide confidence intervals. We therefore had to develop ad-hoc criteria in real time for the application of each GRADE domain under these circumstances. For instance, we decided to use some items from the quality appraisal tool, such as external validation and assessment of the impact of uncertainties, to inform our judgements regarding the GRADE domains of indirectness and imprecision, respectively. These adaptations of GRADE were made over the course of several core team discussions and in close consultation with experts in mathematical modelling.

In the rapid publishing environment in the context of the COVID-19 pandemic and due to the inclusion of preprints, which have not undergone a rigorous peer-review process, there may be an increased risk of publication bias favouring positive findings. However, given the lower burden of publishing null and negative findings on preprint servers it may be possible that including these data sources provides a more holistic picture of the evidence base. Future research should explore the existence and direction of publication and reporting bias in preprints, as well as in peer-reviewed journals addressing the COVID-19 pandemic.

As specified in the Methods, we used a structured approach to narratively synthesise the findings based on the recent guidance

for conducting synthesis without meta-analysis (Campbell 2020). This approach entailed first clearly describing the direction of effect for each individual study and then summarising them across all studies that contributed to a body of evidence. Based on this approach and the null effect chosen as an important threshold, it is possible that the presented findings are biased towards showing a positive effect, as any effect above null was considered as an effect favouring the measure. However, in order to add further nuance, we consistently applied the terms 'unclear' and 'clear' effects to differentiate effect estimates whose confidence intervals overlapped the null (and therefore allowed the possibility of a different direction of effect) from those whose intervals fell only on one side of the null.

Further limitations of the review derive from significant methodological limitations and other deficiencies in the included studies. Lack of proper reporting in many observational studies created challenges in identifying and classifying the non-pharmacological measures. Furthermore, we judged all but one observational study as having a serious risk of bias due to insufficient adjustment for confounders. Stronger quasi-experimental study designs, such as ITS analysis could have improved our confidence in the available evidence. Among the modelling studies included in the analysis, there was insufficient external validation of the models. Often, conducting an external validation of the model output is challenging, when there is a lack of empirical evidence, which often is the cause for the usage of mathematical models in the first place.

Furthermore, we are aware of a considerable body of literature on the unintended consequences of non-pharmacological measures implemented in long-term care facilities on, among others, the mental and physical health of residents (e.g. Lood 2021), the mental health of staff members (e.g. Blanco-Donoso 2021), the mental health of friends and relatives of residents (e.g. Giebel 2021 or Yeh 2020), and the availability and accessibility of health services (e.g. end-of-life care, as in Onwuteaka-Philipsen 2021). However, most of these are case reports (e.g. Asthana 2021), qualitative studies, non-comparative cross-sectional studies (e.g. El Haj 2020a), and uncontrolled before-and-after studies (e.g. El Haj 2020b), and therefore were not included in this review. Furthermore, other studies did not assess the effects of non-pharmacological measures specifically implemented in long-term care facilities, but rather assessed outcomes regarding adverse and other unintended consequences, before and after the pandemic (e.g. in Shoaib 2021). These studies therefore do not allow a clear distinction to be drawn between the effects of the non-pharmacological measures implemented within long-term care facilities and the effects of measures implemented outside the facilities (e.g. additional burdens for staff members due to childcare burdens resulting from school closures) or other social processes and phenomena related to the pandemic affecting the society (e.g. media coverage, fear of infection, or ageism). The evidence from these studies should be considered when developing recommendations or implementing non-pharmacological measures in long-term care facilities.

Finally, we were not able to do a formal assessment of heterogeneity and the moderating factors, as prespecified in our review protocol (New Reference). Instead, we tabulated key factors in the descriptive tables, and presented and discussed them in the review's Results as they were assessed in the individual studies. We suggest referring to these as factors that may potentially explain the variation in the direction or magnitude of effects, or both, rather than as moderating factors.

AUTHORS' CONCLUSIONS

Implications for practice

This review suggests that non-pharmacological measures implemented in long-term care facilities can prevent SARS-CoV-2 infections and their consequences for residents and staff. However, the certainty of evidence synthesised in this rapid review is, with some exceptions, low to very low, due to the limited availability, as well as the design and the quality of available studies. Therefore, true effects may be substantially different from those reported here.

In public health and health policy decision-making, the evidence of effectiveness needs to be weighed against other relevant considerations, such as broader societal implications of implementing public health measures. Given the high morbidity and mortality burden among residents of long-term care facilities prior to or without vaccination coverage, the implementation of measures identified as potentially effective in this review is likely the only reasonable option currently available until satisfactory vaccination rates within these facilities can be achieved, despite concerns about the certainty of evidence.

In the context of high vaccination rates, as is increasingly the case in many high-income countries, the balance of benefits and harms of these measures needs to be critically evaluated. We found limited reliable evidence on adverse and other unintended consequences of these measures, but the adverse consequences for mental and physical health of intrusive measures, such as visiting restrictions or contact regulating measures have been widely discussed both in the context of long-term care facilities and beyond (D'Cruz 2020; Lekamwasam 2020). Depending on the context, the intrusiveness and burden of some of these measures on the vulnerable populations living in long-term care facilities with higher vaccination rates warrants consideration alongside the evidence of their effectiveness.

Implications for research

Given the very high disease burden among residents in long-term care facilities, the limited availability of studies, compared to those in other settings, such as schools, is surprising and concerning. If more emphasis had been placed on identifying effective approaches for preventing contamination of and outbreaks in long-term care facilities and implementing them rapidly during early 2020, it is likely that the overall number of deaths from COVID-19 could have been substantially lower in many countries. Future research examining priority-setting processes in politics, public health, and the further research community is needed to understand the allocation of resources and provide solutions for a rapid, and adaptive pandemic priority-setting process.

Overall, more studies producing stronger evidence on the effectiveness of non-pharmacological measures are needed. While experimental studies, such as cluster-randomised trials would be helpful, they are logistically challenging to implement in the course of a rapidly progressing pandemic, which has severe adverse consequences for the population of interest. Here, quasi-experimental study designs could provide strong enough evidence

of effectiveness for these measures — and could do so in future pandemics. In this context, research on effective surveillance systems providing data required for these measures may be of relevance for mitigating the harmful effects of future pandemics. Ideally, such surveillance systems should provide longitudinal data on the long-term care facility, its population, and the broader geographical and social characteristics to adequately adjust for confounders; the information on the types of measures implemented in the facilities and the degree of adherence to them; as well as the relevant outcome data. Based on such datasets, quasi-experimental study designs such as controlled interrupted-time-series studies or controlled studies based on propensity score matching could allow for the rapid provision of relatively strong evidence of effectiveness of the measures implemented in the facilities. In particular, research on preventing contamination of facilities as well as those that may lead to an outbreak (such as daily pre-entry testing of staff members) would be an important contribution to the evidence base.

Mathematical modelling studies accounted for a significant proportion of studies relevant for this review. However, modelling studies could only partially provide reliable evidence due to common quality concerns and incomplete reporting of their respective setting, limiting the ability to translate study results into meaningful evidence. Modelling studies are not subject to generally accepted guidelines, which partially explains the heterogeneity in the quality of studies and reporting of results, effectively complicating their integration into systematic reviews. This suggests that it would be worthwhile to develop and spread awareness of good practices within the modelling community.

In the context of increasing vaccination rates among residents of long-term care facilities in many countries, it is important for future studies to assess which types of baseline infection control measures should be implemented under which circumstances (e.g. at which incidence rate in the community) in order to strike an acceptable balance between the benefits and burdens of these measures for residents and staff.

Furthermore, more research on the effectiveness of non-pharmacological measures from low- and middle-income countries, and on the adverse effects and other unintended consequences of non-pharmacological measures implemented in long-term care facilities, is needed.

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* Indicates the major publication for the study

CHARACTERISTICS OF STUDIES

Characteristics of included studies *[ordered by study ID]*

Belmin 2020

Study characteristics	
Notes	CoI: “None reported.” Funding: not reported

Delaunay 2020

Study characteristics	
Notes	COI: "C.L.D. received a PhD trainee fellowship from the Canadian Network on Hepatitis C. The Canadian Network on Hepatitis C is funded by a joint initiative of the Canadian Institutes of Health Research (NHC-142832) and the Public Health Agency of Canada. C.L.D. also received a doctoral training award from the Fond de Recherche du Québec eSanté. S.S. received post-doctoral fellowships from the Fond de Recherche du Québec eSanté and the Canadian Institutes of Health Research. Q.D.N. received a doctoral training award from the Fond de Recherche du Québec eSanté and from the Canadian Institutes of Health Research." Funding: not reported

Green 2021

Study characteristics	
Notes	COI: “None.” Funding: “This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.”

Holmdahl 2021

Study characteristics	
Notes	COI: "MJM has received ad hoc speaking fees from Abbott Diagnostics and Roche Diagnostics." Funding: "MJM is supported by the U01 Serological Centers of Excellence Grant. MJM and JH are supported by the DP5 NIH Director’s Award. "

Knock 2021

Study characteristics	
Notes	COI: not reported Funding: "This work was supported by the NIHR HPRU in Modelling and Health Economics, a partnership between PHE, Imperial College London and LSHTM (grant code NIHR200908). We acknowledge funding from the MRC Centre for Global Infectious Disease Analysis (reference MR/R015600/1), jointly funded by the UK Medical Research Council (MRC) and the UK Foreign, Commonwealth & Development

Knock 2021 *(Continued)*

	Office (FCDO), under the MRC/FCDO Concordat agreement and is also part of the EDCTP2 programme supported by the European Union. "

Lipsitz 2020

Study characteristics	
Notes	CoI: “The authors have declared no conflicts of interest for this article.” Funding: “This work was supported by Grant 3U54AG063546-02S3 from the National Institute on Aging, the Massachusetts Executive Office for Health and Human Services, Massachusetts Senior Care Association, and Hebrew SeniorLife in Boston, Massachusetts. Lewis A. Lipsitz holds the Irving and Edyth S. Usen and Family Chair in Geriatric Medicine at Hebrew SeniorLife.”

Lombardo 2021

Study characteristics	
Notes	CoI: “The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.” Funding: not reported

Love 2021

Study characteristics	
Notes	COI: "Drs. Angulo, Mclaughlin, Shea, and Swerdlow reported being employed by Pfizer Vaccines." [...] "Pfizer Inc. reviewed this manuscript and approved the decision to submit the manuscript for publication." Funding: "This work was supported by Pfizer."

McArthur 2021

Study characteristics	
Notes	COI: “CM, MS, GH, NW, and JH are members of interRAI, a not-for-profit international scientific organization. George Heckman receives salary support from the Schlegel Research Chair in Geriatric Medicine.” Funding: “A portion of this work was funded by a grant from Canadian Frailty Network.”

Nguyen 2020

Study characteristics	
Notes	COI: "All authors declare no potential conflicts of interest related to this article." Funding: "This work was funded by the University of Strathclyde as part of L.L.K.N.’s doctoral project."

Reyné 2020

Study characteristics	
Notes	CoI: “None of the authors report any potential conflicts.” Funding: “This work was partly supported by the Occitanie region and the ANR (grant PhyEpi).”

Rolland 2020

Study characteristics	
Notes	CoI: “None of the authors report a conflict of interest.” Funding: “No specific funding was received for this work.”

See 2020

Study characteristics	
Notes	COI: "None" Funding: "This work was funded by the Centers for Disease Control and Prevention."

Shallcross 2021

Study characteristics	
Notes	CoI: “LS reports grants from the Department of Health and Social Care during the conduct of the study, and is a member of the Social Care Working Group, which reports to the Scientific Advisory Group for Emergencies. AH is a member of the New and Emerging Respiratory Virus Threats Advisory Group at the Department of Health. GH is an employee of Palantir Technologies UK, which has a paid contract with the Department of Health and Social Care to provide the data platform that was used for this study. All other authors declare no competing interests.” Funding: “This work was funded by the UK Department of Health and Social Care. We acknowledge Rachel Williams and Anna Quigley from Ipsos MORI, who both led the survey fieldwork, and Julian Sandler from the Office for National Statistics, who supported construction of the tables. This report is independent research funded by the Department of Health and Social Care (COVID-19 surveillance studies). The views expressed in this publication are those of the authors and not necessarily those of the NHS or the Department of Health and Social Care.”

Smith 2020a

Study characteristics	
Notes	COI: "LO reports grants from Pfizer, outside the submitted work. All other authors report no competing interests." Funding: "The work was supported directly by internal resources from the French National Institute for Health and Medical Research, the Institut Pasteur, the Conservatoire National des Arts et Métiers, and the University of Versailles–Saint-Quentin-en-Yvelines/University of Paris-Saclay. This study received funding from the French Government’s “Investissement d’Avenir” programme, Laboratoire d’Excellence “Integrative Biology of Emerging Infectious Diseases” (Grant ANR-10-LABX-62- IBEID). DS is

Smith 2020a *(Continued)*

	supported by a Canadian Institutes of Health Research Doctoral Foreign Study Award (Funding Reference Number 164263) as well as the French government through its National Research Agency project SPHINX-17-CE36-0008-01. KP is supported by the National Institute for Health Research (NIHR) Health Protection Research Unit in Healthcare Associated Infections and Antimicrobial Resistance at the University of Oxford in partnership with Public Health England (grant number NIHR200915).

Smith 2020b

Study characteristics	
Notes	COI: "LO reports grants from Pfizer, outside the submitted work. All other authors report no competing interests." Funding: "The work was supported by the French National Research Agency (ANR) project MOD-COV (ANR-20-COVI- 0071). DS is supported by a Canadian Institutes of Health Research Doctoral Foreign Study Award (Funding Reference Number 164263) as well as the ANR project SPHINX-17-CE36-0008-01."

Telford 2020

Study characteristics	
Notes	CoI: “No potential conflicts of interest were disclosed.” Funding: “Dr. Gandhi is supported by NIH/NIAID K24AI114444.”

Telford 2021

Study characteristics	
Notes	CoI: “None of the authors report a conflict of interest.” Funding: “No specific funding was received for this work.”

Tsoungui 2021

Study characteristics	
Notes	COI: "The authors have declared that no competing interests exist" Funding: "K. A. S. could not have put together the research team without the supported by the German Academic Exchange (DAAD; https://www.daad.de/de/; Project-ID 57417782), the Sächsisches Staatsministerium für Wissenschaft, Kultur und Tourismus and Sächsische Aufbaubank – Förderbank (SMWK-SAB; https://www.smwk.sachsen.de/; https://www.sab.sachsen.de/; project "Innovationsvorhaben zur Profilschärfung an Hochschulen für angewandte Wissenschaften", Project-ID 100257255), the Federal Ministry of Education and Research (BMBF) and the DLR (Project-ID 01DQ20002; https://www.bmbf.de/; https://www.dlr.de/). G. N. is supported by the German Academic Exchange (DAAD; https://www.daad.de/de/; Project-ID 57479556). The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript."

Vijh 2021

Study characteristics	
Notes	CoI: "All authors report no conflicts of interest relevant to this article." Funding: "No financial support was provided relevant to this article."

Vilches 2020

Study characteristics	
Notes	COI: Dr. Joanne M. Langley reports that her institution has received funding for research studies from Sanofi Pasteur, GlaxoSmithKline, Merck, Janssen and Pfizer. Dr. Joanne M. Langley also holds the CIHR-GSK Chair in Pediatric Vaccinology at Dalhousie University. Other authors declare no competing interests. Funding: Seyed Moghadas: CIHR (OV4 — 170643), COVID-19 Rapid Research; Natural Sciences and Engineering Research Council of Canada; and Canadian Foundation for Innovation. Alison Galvani: NSF (RAPID - 2027755), NIH (1RO1AI151176-01). Thomas N. Vilches: São Paulo Research Foundation (FAPESP), grant 2018/24811-1. Lauren Cipriano: Society for Medical Decision Making COVID-19 Decision Modeling Initiative funded by the Gordon and Betty Moore Foundation through Grant GBMF9634 to Johns Hopkins University and a Western University Catalyst Research Grant. The funders had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; preparation, review, or approval of the manuscript; and decision to submit the manuscript for publication.

Wilmink 2020

Study characteristics	
Notes	COI: "GW, IS, DM, JG, GZ, SS, and SM are employees of CarePredict. HF serves as an advisor to CarePredict corporation." Funding: not reported

COI: conflict of interest;

Characteristics of excluded studies *[ordered by study ID]*

Study	Reason for exclusion
Alvargonzalez 2020	This study does not assess the effect of NPIs in LTCFs
Bernabeu-Wittel 2020	This study provides no eligible comparator group/counterfactual
Birgand 2020	This study provides no eligible comparator group/counterfactual
Brainard 2020	This study focuses on risk factors, rather than an eligible interventions
Buntinx 2020	This study provides no eligible comparator group/counterfactual
Caspi 2020	This study does not assess the effect of NPIs in LTCFs
Cheung 2020	This reference is a protocol and no conducted study has been identified. Study does not allow for a clear distinction between interventions implemented in the general population (e.g. general lock-

Study	Reason for exclusion
	down in the society) and related events (e.g. increased number of cases in society and media coverage) from the measures implemented in the facility.
Constantino-Shor 2020	This study does not assess the effect of NPIs in LTCFs
Danilovich 2020	This study provides no eligible comparator group/counterfactual
del Ser 2021	This study does not explicitly focus on a population in LTCFs
de Villaumbrosia 2020	This study does not assess the effect of NPIs in LTCFs
Dittmar 2021	This study does not assess the effect of NPIs in LTCFs
Dolveck 2020	This study provides no eligible comparator group/counterfactual
Echeverría 2020	This study does not assess the effect of NPIs in LTCFs
El Haj 2020	This study provides no eligible comparator group/counterfactual
Figueroa 2020	This study does not assess the effect of NPIs in LTCFs
Franco 2020	This study does not assess the effect of NPIs in LTCFs
Goto 2020	This study provides no eligible comparator group/counterfactual
Hellewell 2020	This study does not assess the effect of NPIs in LTCFs
Jackson 2020	This study does not assess the effect of NPIs in LTCFs
Jones 2020	This study does not assess the effect of NPIs in LTCFs
Karaivanov 2021	This study does not assess the effect of NPIs in LTCFs
Lee 2020	This study does not assess the effect of NPIs in LTCFs
Lennon 2020	This study does not assess the effect of NPIs in LTCFs
Leontjevas 2020	This study provides no eligible comparator group/counterfactual
Leskovic 2020	This study does not assess the effect of NPIs in LTCFs
Lombardo 2020b	This study does not report an eligible outcome
Martín 2020	This study does not assess the effect of NPIs in LTCFs
Martinchek 2020	This study provides no eligible comparator group/counterfactual
Martinsson 2021	This study does not assess the effect of NPIs in LTCFs
McBee 2020	This study provides no eligible comparator group/counterfactual
McConeghy 2020	This study does not assess the effect of NPIs in LTCFs
Miller 2020	This study does not assess the effect of NPIs in LTCFs

Study	Reason for exclusion
Montoya 2020	This study provides no eligible comparator group/counterfactual
O'Caoimh 2020	This study provides no eligible comparator group/counterfactual
Oberhammer 2020	This study does not assess the effect of NPIs in LTCFs
Psevdos 2021	This study provides no eligible comparator group/counterfactual
Riello 2020	This study provides no eligible comparator group/counterfactual
Rothgang 2020	This study provides no eligible comparator group/counterfactual
Schuengel 2020	Study does not allow for a clear distinction between interventions implemented in the general population (e.g. general lockdown in society) and related events (e.g. increased number of cases in society and media coverage) from the measures implemented in the facility.
Seifert 2020	This study does not assess the effect of NPIs in LTCFs
Shimotsu 2021	This study does not assess the effect of NPIs in LTCFs
Shum 2020	This study provides no eligible comparator group/counterfactual
Sizoo 2020	This study uses qualitative methodology only
Stall 2020	This study does not assess the effect of NPIs in LTCFs
Strang 2020	This study provides no eligible comparator group/counterfactual
Suárez-Gonzáles 2020	This study provides no eligible comparator group/counterfactual
Tarteret 2020	This study does not assess the effect of NPIs in LTCFs
Taylor 2020	This study provides no eligible comparator group/counterfactual
Van der Roest 2020	This study provides no eligible comparator group/counterfactual
Van Maurik 2020	This study does not assess the effect of NPIs in LTCFs
Verbeek 2020	This study does not assess any eligible outcome of interest
Wang 2020	This study does not assess the effect of NPIs in LTCFs
Yang 2020	This study does not assess the effect of NPIs in LTCFs

LTCF/s: long-term care facility/facilities; **NPI:** non-pharmacological intervention

Characteristics of ongoing studies *[ordered by study ID]*

Posar 2020

Study name	Urgent behavioral health phone calls from skilled nursing and long-term care facilities during COVID-19 lockdown
Starting date	Unclear

Posar 2020 *(Continued)*

Contact information	Steven Posar, MD CEO at GuideStar Eldercare
Notes	Preliminary findings presented at a conference; no peer-reviewed study or preprint published so far

ADDITIONAL TABLES

Table 1. Risk of bias assessment of observational studies assessed with the ROBINS-I tool

Study ID	intervention categories	Outcomes	Overall rating	Predicted direction of bias on effect	Bias due to confounding	Bias in selection of participants into the study	Bias in classification of intervention	Bias due to deviation from intended intervention	Bias due to missing data	Bias in measurement of outcomes	Bias in selection of the reported result
Belmin 2020	1. Self-confinement of staff with residents	1. Infections among residents 1. Infections among staff members 3. Contamination of the facilities 5. Deaths among residents	Serious	Unclear	Serious	Moderate	Low	Serious	Low	Moderate	Moderate
Green 2021	2. Contact-reduction measures	3. Outbreaks	Serious	Likely favouring the control	Serious	Moderate	Serious	Moderate	Low	Low	Moderate
Lipsitz 2020	2. Mask and PPE use 3. Separating infected and non-infected residents	1. Number of infections: mean weekly infection rate . 1. Number of infections: odds of having a weekly infection rate of zero infections	Serious	Likely favouring the measure	Serious	Low	Low	Serious	Low	Moderate	Serious
		5. Number of deaths: mean weekly mortality rates 5. Number of deaths: odds of having a weekly mortality rate of zero deaths	Serious	Likely towards the null	Serious	Low	Low	Serious	Low	Serious	Serious
	5. Multicomponent outbreak control measures	1. Number of infections: mean weekly infections rates	Serious	Unclear	Serious	Low	Low	Moderate	Low	Moderate	Moderate

Table 1. Risk of bias assessment of observational studies assessed with the ROBINS-I tool *(Continued)*

		1. Number of infections: odds of having a weekly infection rate of zero infections									
		5. Number of deaths: weekly mortality rates 5. Number of deaths: odds of weekly mortality rate of zero deaths	Serious	Likely towards the null	Serious	Low	Low	Moderate	Low	Serious	Moderate
Lombardo 2021	4. Isolation of cases	3. Outbreaks	Serious	Unclear	Serious	Moderate	Serious	Serious	No information	Moderate	Moderate
McArthur 2021	1. Admission restrictions for visitors (in combination of measures to reduce the adverse effects of the visiting restrictions)	6. Adverse and other unintended mental or physical health outcomes	Serious	Unclear	Serious	Low	Low	Serious	Low	Moderate	Serious
Reyné 2020	2. Mask and PPE use	1. Number of infections among residents	Serious	Unclear	Serious	Moderate	Low	Serious	Low	Moderate	Moderate
Shallcross 2021	1. Admission restrictions for new residents 1. Admission restrictions for new residents	1. Infections among residents 1. Infections among staff members 1. Large outbreaks (≥20 cases) 2. Contamination	Serious	Unclear	Serious	Low	Moderate	Serious	Low	Moderate	Moderate
	2. Barrier nursing for infected residents 2. Cleaning frequency 3. Isolation of cases	1. Infections among residents 1. Infections among staff members 1. Large outbreaks (≥20 cases)	Serious	Likely favouring the control	Serious	Low	Serious	Serious	Low	Moderate	Moderate

Table 1. Risk of bias assessment of observational studies assessed with the ROBINS-I tool *(Continued)*

	3. Separating infected and non-infected residents	3. Outbreaks									
Telford 2020	3. Routine testing of residents and staff independent of symptom status	1. Infections among residents 1. Infections among staff	Serious	Unclear	Serious	Moderate	Low	Serious	Low	Moderate	Moderate
	3. Routine testing of residents and staff independent of symptom status	2. Hospitalisations among residents 2. Hospitalisations among staff 5. Deaths among residents 5. Deaths among staff	Serious	Unclear	Serious	Moderate	Low	Serious	Low	Low	Moderate
Vijh 2021	1. Multicomponent outbreak control measures	1. Infections among residents 1. Infections among staff	Moderate	Unclear	Moderate	Low	Moderate	Moderate	Low	Low	Moderate

Table 2. Risk of bias assessment of observational studies not assessed with the ROBINS-I tool

Study ID	Telford 2021	Rolland 2020
intervention categories	1. Quarantine for new admissions 2. mask and PPE use 2. Cleaning and environmental hygiene measures 2. Cleaning frequency 2. Contact reduction measures 3. Symptom-based surveillance 4. Separating infected and non-infected residents	2. Mask and PPE use 2. Contact reduction measures 2. Personal hygiene measures and practices 2. Multicomponent contact and transmission-reducing measures 2. Cohorting residents and staff
Outcomes	1. Infections: size of outbreak	3. Outbreaks
Effect	Starting and adhering to intervention	Starting and adhering to intervention
Overall study bias	Serious	Serious
Were the groups comparable other than the outcome status in cases or absence of the outcome status in controls?	Probably no	Probably no
	Serious	Serious
Were cases and controls matched appropriately?	Probably no	Probably no
	Serious	Serious
Were the same criteria used for identification of cases and controls?	Yes	Yes
	Low	Low
Was exposure measured in a standard, valid and reliable way?	Probably no	Probably no
	Serious	Serious
Was exposure measured in the same way for cases and controls?	Yes	Yes
	Low	Low
Were confounding factors identified?	No	Yes
	Serious	Moderate
Were strategies to deal with confounding factors stated?	No	Yes
	Serious	Low
Were outcomes assessed in a standard, valid and reliable way for cases and controls?	Probably yes	Probably no
	Moderate	Serious

Table 2. Risk of bias assessment of observational studies not assessed with the ROBINS-I tool *(Continued)*

Was the exposure period of interest long enough to be meaningful?	Yes	Yes
	Low	Low
Was appropriate statistical analysis used?	No	Probably yes
	Serious	Moderate

Table 3. Quality appraisal of modelling studies

	Model structure		Input data		Validation (external)		Validation (internal)		Uncertainty	Transparency	Overall
	Reporting and justification	Reasonableness of assumptions and justifications	Reporting and justification	Reasonableness of assumptions and justifications	Reporting of validation	Extent of validation	Reporting of validation	Extent of validation		Replicability of model results based on materials provided	
Delaunay 2020	No to minor concerns	Major concerns	No to minor concerns	No to minor concerns	Major concerns	Major concerns	Major concerns	Major concerns	Moderate concerns	No to minor concerns	Critical concerns
Holmdahl 2021	No to minor concerns	No to minor concerns	No to minor concerns	No to minor concerns	Major concerns	Major concerns	Major concerns	Major concerns	Moderate concerns	No to minor concerns	Moderate concerns
Knock 2021	No to minor concerns	Moderate concerns	No to minor concerns	Moderate concerns	Major concerns	Major concerns	Major concerns	Major concerns	Moderate concerns	No to minor concerns	Moderate concerns
Love 2021	Major concerns	Moderate concerns	Moderate concerns	Major concerns	Major concerns	Major concerns	Major concerns	Major concerns	Major concerns	Moderate concerns	Critical concerns
Nguyen 2020	No to minor concerns	Moderate concerns	No to minor concerns	No to minor concerns	Moderate concerns	Major concerns	Major concerns	Major concerns	Moderate concerns	Major concerns	Moderate concerns
See 2020	Moderate concerns	Major concerns	No to minor concerns	No to minor concerns	Major concerns	Major concerns	Major concerns	Major concerns	Major concerns	No to minor concerns	Critical concerns
Smith 2020a	No to minor concerns	Moderate concerns	No to minor concerns	No to minor concerns	Moderate concerns	Major concerns	Moderate concerns	Moderate concerns	Moderate concerns	Moderate concerns	Moderate concerns
Smith 2020b	Major concerns	Moderate concerns	Moderate concerns	Moderate concerns	Major concerns	Major concerns	Major concerns	Major concerns	Major concerns	Moderate concerns	Serious concerns
Tsoungui 2021	No to minor concerns	Major concerns	Moderate concerns	Major concerns	Major concerns	Major concerns	Moderate concerns	Major concerns	Major concerns	Moderate concerns	Critical concerns

Table 3. Quality appraisal of modelling studies *(Continued)*

Vilches 2020	No to minor concerns	No to minor concerns	No to minor concerns	No to minor concerns	Moderate concerns	Major concerns	Major concerns	Major concerns	Moderate concerns	No to minor concerns	Moderate concerns
Wilmink 2020	Moderate concerns	Major concerns	No to minor concerns	Moderate concerns	Major concerns	Major concerns	Major concerns	Major concerns	Major concerns	Major concerns	Critical concerns

APPENDICES

Appendix 1. Eligibility criteria

	Inclusion	Exclusion
Intervention	Study assesses a measure implemented with the intention to protect residents of LTCFs from SARS-CoV-2 transmission and infection and COVID-19 disease morbidity and mortality outcomes	
	The measure is a non-pharmacological intervention.	The measure is a pharmacological intervention (e.g. prophylactic drug treatment of patients in LTCFs).
	The measure is a deviation from the regular praxis conducted outside the context of a pandemic or epidemic (e.g. basic food hygiene).	
Setting	The measure is implemented in the setting of LTCFs (as defined in the protocol).	The measure is implemented in institutions primarily or exclusively providing • acute (medical) care • rehabilitative care • palliative care. The measure is implemented in the setting of home care and home care services. LTCFs that are primarily or exclusively focused on paediatric populations (> 75% of the population is < 18 years old) will be excluded.
		The measure is implemented outside the setting of LTCFs; independent of the effect on transmission within LTCFs (e.g. school closures affecting the transmission in LTCFs through the overall pandemic progression).
Population	Study focuses on adult residents living in LTCFs or nursing staff or non-nursing staff or individuals visiting LTCFs on a regular or irregular basis (for work and non-work-related purposes) or other individuals directly affected by measures implemented in LTCFs.	Study focuses on the general population. Study focuses on the general population primarily of individuals not living and/or working in the LTCF. Study focuses primarily or exclusively on paediatric populations (> 75% of the study population is < 18 years old).
Outcomes	Study reports on at least one of the following primary outcome categories. • SARS-CoV-2 infections avoided due to the measure • Contaminations of LTCFs avoided due to the measure • Outbreaks in LTCFs avoided due to the measure • COVID-19-related hospitalisations avoided due to the measure	Publications assessed/reports on • societal or ecological outcomes (e.g. changes in waste production or energy consumption) • economic or financial outcomes (e.g. studies estimating cost or resource use of an intervention) or • (other) implementation-related outcomes (e.g. reported acceptability or adherence to the measure, reported barriers for implementa-

(Continued)

	• COVID-19-related deaths avoided due to the measure • Adverse and other unintended mental or physical health outcomes (e.g. rate of residents experiencing loneliness; incidence or severity of depression; rate of psychogeriatric hospitalisations, health-related quality of life, changes in health-related behaviour or metabolic risk factors, such as weight change or smoking behaviour)	tion) without reporting on any of the primary or secondary outcome categories.
Study types	Study provides quantitative data on the outcomes of interest	Study provides only qualitative data on the outcomes of interest
	Study is a RCT, cRCT, NRCT, CBA, or ITS	Study is an opinion paper, editorial, commentary
	Study is a mechanistic, empirical, or hybrid mathematical modelling study	Study is a non-comparative study (e.g. case series)
Language	Studies published in Armenian, English, French, German, Italian, Russian and Spanish	Studies in languages other than those listed

CBA: controlled before after study; **cRCT:** cluster-randomised controlled trial; **ITS:** interrupted time series; **LTCFs:** long-term care facilities; **NRCT:** non-randomised controlled trial; **RCT:** randomised controlled trial

Appendix 2. Search Strategies

Cochrane COVID-19 Study Register

"nursing home" OR "nursing homes" OR "care home" OR "care homes" OR "nursing residence" OR "nursing residences" OR "nursing residency" OR "nursing residencies" OR "nursing care facility" OR "nursing care facilities" OR "nursing care home" OR "nursing care homes" OR "nursing care residence" OR "nursing care residences" OR "nursing residency" OR "nursing residencies" OR "senior citizen home" OR "senior citizens home" OR "senior citizen homes" OR "senior citizens homes" OR "senior citizen facility" OR "senior citizen facilities" OR "senior citizens facility" OR "senior citizens facilities" OR "senior citizen residence" OR "senior citizen residences" OR "senior citizen residency" OR "senior citizen residencies" OR "senior citizens residence" OR "senior citizens residences" OR "senior citizens residency" OR "senior citizens residencies" OR "assisted living facility" OR "assisted living facilities" OR "assisted living home" OR "assisted living homes" OR "assisted living residence" OR "assisted living residences" OR "assisted living residency" OR "assisted living residencies" OR "assisted living community" OR "assisted living communities" OR "skilled nursing facility" OR "skilled nursing facilities" OR "skilled nursing residence" OR "skilled nursing residences" OR "skilled nursing residency" OR "skilled nursing residencies" OR "longterm care home" OR "longterm care homes" OR "longterm care facility" OR "longterm care facilities" OR "longterm care residence" OR "longterm care residences" OR "longterm care residency" OR "longterm care residencies" OR "longterm care resident" OR "longterm care residents" OR "long-term care resident" OR "long-term care residents" OR "long-term care home" OR "long-term care homes" OR "long-term care facility" OR "long-term care facilities" OR "long-term care residence" OR "long-term care residences" OR "long-term care residency" OR "long-term care residencies" OR "longterm care residence" OR "longterm care residences" OR "longterm care residency" OR "longterm care residencies" OR "convalescent home" OR "convalescent homes" OR "convalescent hospital" OR "convalescent hospitals" OR "convalescent facility" OR "convalescent facilities" OR "convalescent residence" OR "convalescent residences" OR "convalescent residency" OR "convalescent residencies" OR "retirement facility" OR "retirement facilities" OR "retirement home" OR "retirement homes" OR "retirement residence" OR "retirement residences" OR "retirement residency" OR "retirement residencies" OR "rest home" OR "rest homes" OR "residential care home" OR "residential care homes" OR "residential care facility" OR "residential care facilities" OR "home of the aged" OR "homes of the aged" OR "extended care facility" OR "extended care facilities" OR "extended care home" OR "extended care homes" OR "old age home" OR "old age homes" OR "old age residence" OR "old age residences" OR "old age residency" OR "old age residencies" OR "old peoples home" OR "old people home" OR "old people's home" OR "old people homes" OR "old peoples homes" OR "old people's homes" OR "old people residence" OR "old people residences" OR "old people residency" OR "old people residencies" OR "old peoples residence" OR "old peoples residences" OR "old peoples residency" OR "old peoples residencies" OR "old people's residence" OR "old people's residences" OR "old people's residency" OR "old people's residencies" OR "charitable home" OR "charitable homes" OR "charitable facility" OR "charitable facilities"

World Health Organization COVID-19 Global literature on coronavirus disease (excluding MEDLINE/PubMed)

"nursing home" OR "nursing homes" OR "nursing residence" OR "nursing residences" OR "nursing care" OR "senior citizen home" OR "senior citizens home" OR "senior citizen homes" OR "senior citizens homes" OR "assisted living" OR "longterm care" OR "long-term care"

OR "retirement facility" OR "retirement facilities" OR "retirement home" OR "retirement homes" OR "retirement residence" OR "retirement residences" OR "rest home" OR "care home" OR "care homes" OR "residential care" OR "extended care facility" OR "extended care facilities" OR "old age home" OR "old age homes" OR "charitable home" OR "charitable homes"

Web of Science (Science Citation Index and Emerging Sources Citation Index) Clarivate

1 TI=((COVID OR COVID19) OR ("SARS-CoV-2" OR "SARS-CoV2" OR SARSCoV2 OR "SARSCoV-2" OR "SARS coronavirus 2") OR ("2019 nCoV" OR "2019nCoV" OR "2019-novel CoV" OR "nCov 2019" OR "nCov 19") OR ("severe acute respiratory syndrome coronavirus 2" OR "novel coronavirus disease" OR "novel corona virus disease" OR "corona virus disease 2019" OR "coronavirus disease 2019" OR "novel coronavirus pneumonia" OR "novel corona virus pneumonia") OR ("severe acute respiratory syndrome coronavirus 2"))

Indexes=SCI-EXPANDED, ESCI Timespan=All years

2 AB=((COVID OR COVID19) OR ("SARS-CoV-2" OR "SARS-CoV2" OR SARSCoV2 OR "SARSCoV-2" OR "SARS coronavirus 2") OR ("2019 nCoV" OR 2019nCoV OR "2019-novel CoV" OR "nCov 2019" OR "nCov 19") OR ("severe acute respiratory syndrome coronavirus 2" OR "novel coronavirus disease" OR "novel corona virus disease" OR "corona virus disease 2019" OR "coronavirus disease 2019" OR "novel coronavirus pneumonia" OR "novel corona virus pneumonia") OR ("severe acute respiratory syndrome coronavirus 2"))

Indexes=SCI-EXPANDED, ESCI Timespan=All years

3 #2 OR #1

Indexes=SCI-EXPANDED, ESCI Timespan=All years

4 TI=(("nursing home*" OR "care home*" OR "nursing residenc*" OR "nursing care facilit*" OR "nursing care home*" OR "nursing care residenc*" OR "senior citizen* home*" OR "senior citizen* facilit*" OR "senior citizen* residenc*" OR "assisted living facilit*" OR "assisted living home*" OR "assisted living residenc*" OR "assisted living communit*" OR "skilled nursing facilit*" OR "skilled nursing home*" OR "skilled nursing residenc*" OR "longterm care home*" OR "longterm care facilit*" OR "longterm care residen*" OR "long-term care home*" OR "long-term care facilit*" OR "long-term care residen*" OR "convalescent home*" OR "convalescent hospital*" OR "convalescent facilit*" OR "convalescent residenc*" OR "retirement facilit*" OR "retirement home*" OR "retirement residenc*" OR "rest home*" OR "residential care home*" OR "residential care facilit*" OR "home of the aged" OR "homes of the aged" OR "extended care facilit*" OR "extended care home*" OR "old age home*" OR "old age residenc*" OR "old people* home*" OR "old people* residenc*" OR LTCF OR "charitable hom*" OR "charitable facilit*"))

Indexes=SCI-EXPANDED, ESCI Timespan=All years

5 AB=(("nursing home*" OR "care home*" OR "nursing residenc*" OR "nursing care facilit*" OR "nursing care home*" OR "nursing care residenc*" OR "senior citizen* home*" OR "senior citizen* facilit*" OR "senior citizen* residenc*" OR "assisted living facilit*" OR "assisted living home*" OR "assisted living residenc*" OR "assisted living communit*" OR "skilled nursing facilit*" OR "skilled nursing home*" OR "skilled nursing residenc*" OR "longterm care home*" OR "longterm care facilit*" OR "longterm care residen*" OR "long-term care home*" OR "long-term care facilit*" OR "long-term care residen*" OR "convalescent home*" OR "convalescent hospital*" OR "convalescent facilit*" OR "convalescent residenc*" OR "retirement facilit*" OR "retirement home*" OR "retirement residenc*" OR "rest home*" OR "residential care home*" OR "residential care facilit*" OR "home of the aged" OR "homes of the aged" OR "extended care facilit*" OR "extended care home*" OR "old age home*" OR "old age residenc*" OR "old people* home*" OR "old people* residenc*"" OR LTCF OR "charitable hom*" OR "charitable facilit*"))

Indexes=SCI-EXPANDED, ESCI Timespan=All years

6 AB=((elder* or senior* or aged or "old age" or "old people" or "old person*") NEAR/3 (nursing or "long-term care" or "LTC" or "long term care") NEAR/3 (home or homes or hous* or residenc* or facilit* or hospital*))

Indexes=SCI-EXPANDED, ESCI Timespan=All years

7 #6 OR #5 OR #4

Indexes=SCI-EXPANDED, ESCI Timespan=All years

8 #7 AND #3

Indexes=SCI-EXPANDED, ESCI Timespan=2020-2021

CINAHL EBSCO

Query

S10 S4 AND S9

Limiters - Published Date: 20200101-20210231

S9 S5 OR S6 OR S7 OR S8

S8 AB ((elder* or senior*or aged or "old age" or "old people" or "old person*") NEAR/3 (nursing or "long-term care" or "LTC" or "long term care") NEAR/3 (home or homes or hous* or residenc* or facilit* or hospital*))

S7 AB (nursing home* or care home* or nursing residen* or nursing care facilit* or nursing care home* or nursing care residen* or senior citizen* home* or senior citizen* faclit* or senior citizen* residen* or assisted living facilit* or assisted living home* or assisted living residen* or assisted living communit* or skilled nursing facilit* or skilled nursing home* or skilled nursing residen* or longterm care home* or longterm care facilit* or longterm care residen* or long-term care home* or long-term care facilit* or long-term care residen* or convalescent home* or convalescent hospital* or convalescent facilit* or convalescent residen* or retirement facilit* or retirement home* or retirement residen* or rest home* or Residential care home* or Residential care facilit* or home of the aged or homes of the aged or extended care facilit* or extended care home* or old age home* or old age residen* or old people* home* or old people* residen* or LTCF or charitable hom* or charitable facilit*)

S6 TI (nursing home* or care home* or nursing residen* or nursing care facilit* or nursing care home* or nursing care residen* or senior citizen* home* or senior citizen* faclit* or senior citizen* residen* or assisted living facilit* or assisted living home* or assisted living residen* or assisted living communit* or skilled nursing facilit* or skilled nursing home* or skilled nursing residen* or longterm care home* or longterm care facilit* or longterm care residen* or long-term care home* or long-term care facilit* or long-term care residen* or convalescent home* or convalescent hospital* or convalescent facilit* or convalescent residen* or retirement facilit* or retirement home* or retirement residen* or rest home* or Residential care home* or Residential care facilit* or home of the aged or homes of the aged or extended care facilit* or extended care home* or old age home* or old age residen* or old people* home* or old people* residen* or LTCF or charitable hom* or charitable facilit*)

S5 (MH "Nursing Home Personnel") OR (MH "Nursing Home Patients") OR (MH "Nursing Homes")

S4 S1 OR S2 OR S3

S3 AB ("SARS-CoV-2" OR "SARS-CoV2" OR "SARSCoV-2" OR SARSCoV2 OR "SARS-CoV*" OR SARSCoV* OR "severe acute respiratory syndrome 2" OR "severe acute respiratory syndrome cov*" OR "Covid-19" OR Covid19* OR Covid OR nCoV* OR 2019nCoV* OR 19nCoV* OR "HCoV-19" OR coronavirus* OR "corona virus*") OR AB ("SARS-CoV-2" OR "SARS-CoV2" OR "SARSCoV-2" OR SARSCoV2 OR "SARS-CoV*" OR SARSCoV* OR "severe acute respiratory syndrome 2" OR "severe acute respiratory syndrome cov*" OR "Covid-19" OR Covid19* OR Covid OR nCoV* OR 2019nCoV* OR 19nCoV* OR "HCoV-19" OR coronavirus* OR "corona virus*")

S2 TI ("SARS-CoV-2" OR "SARS-CoV2" OR "SARSCoV-2" OR SARSCoV2 OR "SARS-CoV*" OR SARSCoV* OR "severe acute respiratory syndrome 2" OR "severe acute respiratory syndrome cov*" OR "Covid-19" OR Covid19* OR Covid OR nCoV* OR 2019nCoV* OR 19nCoV* OR "HCoV-19" OR coronavirus* OR "corona virus*") OR AB ("SARS-CoV-2" OR "SARS-CoV2" OR "SARSCoV-2" OR SARSCoV2 OR "SARS-CoV*" OR SARSCoV* OR "severe acute respiratory syndrome 2" OR "severe acute respiratory syndrome cov*" OR "Covid-19" OR Covid19* OR Covid OR nCoV* OR 2019nCoV* OR 19nCoV* OR "HCoV-19" OR coronavirus* OR "corona virus*")

S1 (MH "Coronavirus") OR (MH "Coronavirus Infections") OR (MH "COVID-19")

Appendix 3. Overview of items in data extraction form

Study information

- Study ID
- Study title
- Publication year
- Study source (journal, report, preprint publication)
- For preprint publication only: date of publication
- Funding source
- Reported conflicts of interest

Study design

- Study type (e.g. randomised controlled trial, non-randomised controlled trial, controlled before after study, interrupted time series, mechanistic model, empirical model, hybrid model)
- Verbal summary of study type (e.g. “deterministic compartmental SEIR-model”)
- Comments

Population, setting and context

- Overall number of participants
- Population targeted by intervention (residents, nursing staff, non-nursing staff, visitors)
- Population intended to be protected by intervention (residents, nursing staff, non-nursing staff, visitors)
- Profile of long-term care facility (LTCF) residents (e.g. age, sex, and morbidity-profile of residents, socio-economic status)
- Facility type
- Implementation level (e.g. on the level of LTCFs, individual wards within LTCFs)
- Context-related factors regarding community transmission and infection risk outside the LTCFs (e.g. 7-day incidence rate at time of implementation of the measures)
- Context-related factors regarding institutional risk factors for infection and outbreaks within LTCFs (e.g. number of residents, staff:resident ratio)
- Other/additional characteristics of the LTCF
- Co-Interventions implemented in the LTCFs intended to reduce or prevent SARS-CoV-2 infections (i.e. those that were reported in the study but not assessed)
- Co-Interventions implemented in the LTCFs intended to prevent or mitigate adverse effects of measures intended to reduce or prevent SARS-CoV-2 infections (e.g. regular video calls in intervention and control group)
- Geographical location (e.g. country where study is conducted)
- Comments

Intervention

- Domain(s) intervention
- Category/categories of intervention
- Verbal summary of the measure(s) and implementation
- Verbal summary of comparator/counterfactual
- Level of intervention (i.e. individual, ward, nursing home, multiple, other)
- Rationale, theory, or goal of the elements essential to the intervention (as reported)
- Physical or informational materials used in the intervention, including those provided to participants or used in intervention delivery or in training of intervention providers
- Procedures, activities, and/or processes used in the intervention, including any enabling or support activities
- Provider of the intervention (including expertise, background and any specific training given)
- Modes of delivery of the intervention (such as face-to-face or by some other mechanism, such as internet or telephone, provided individually or in a group)
- Type(s) of location(s) where the intervention occurred, including any necessary infrastructure or relevant features
- When and how much: describe the number of times the intervention was delivered and over what period of time including the number of sessions, their schedule, and their duration, intensity or dose.
- Tailoring: in tailored interventions, not all participants receive an identical intervention. Was this intervention planned to be personalised, titrated or adapted?
- Modification: unforeseen modifications to the intervention can occur during the course of the study, particularly in early studies. Was this intervention modified during the course of the study?
- How well (planned): fidelity refers to the degree to which an intervention happened in the way the investigators intended it to ('how well' the intervention was received or delivered).
- How well (actual): for various reasons, an intervention, or parts of it, might not be delivered as intended, thus affecting the fidelity of the intervention. If intervention adherence or fidelity was assessed, describe the extent to which the intervention was delivered as planned.

Outcomes (repeated for each outcome) and results

- Outcome category
  * SARS-CoV-2 transmission-related outcomes and COVID-19 disease-related morbidity and mortality outcomes
  * Outcomes regarding quality of life, social well-being, and mental health
  * Outcomes regarding physical health beyond COVID-19
- Verbal description of outcome
- Level on which outcome is assessed (i.e. individuals, aggregate on the level of wards or system level)
- Length of follow-up
- Estimate related to the impact of measure(s) implemented in the LTCF setting
- Summary of overall impact of measure(s) implemented in the LTCF setting
- Comments

Appendix 4. Tool for quality appraisal of modelling studies

Criteria used for assessing the quality of individual modelling studies, developed from Burns 2021.

Domain	Source	Questions
Model structure	Philips 2006	1. Are the structural assumptions transparently stated together with their respective justifications? Guidance: Assess whether all structural model assumptions and model components are explicitly stated and whether the authors substantiate these assumptions either through theoretical reasoning or through prior knowledge from the literature. 2. Are the structural assumptions and justifications reasonable given the overall objective, perspective and scope of the model? Guidance: Assess the appropriateness of the model structure based on the provided justifications. Consider whether the structural assumptions reflect existing knowledge about the phenomenon of interest in the literature and whether these assumptions portray the specific situation correctly and comprehensively enough.
Input data	Caro 2014	3. Are the input parameters and data transparently stated? Guidance: Assess whether the values of all inputs are explicitly stated with their respective sources. Possible sources of inputs include but are not limited to the scientific literature or theoretical reasoning. If the source data cannot be employed directly, has the conversion to model input data been described appropriately? 4. Are the input parameters and data suitable to reliably populate the model? Guidance: Consider whether the values for the inputs used seem reasonable. Additionally, examine if the stated sources are trustworthy and indicate plausibility of the used parameters. Possible indicators are whether an assessment of accuracy is possible or whether the sources have been described allowing for an assessment of quality of the inputs. Consider whether the inputs used match the conditions under which they are used in the model. If input data are used to calibrate model parameters, is the calibration process sufficiently documented and do model predictions reasonably describe the data?
Validation (external)	Caro 2014	5. Have indications of external validity been reported? Guidance: Consider whether there has been a process of comparing model predictions against independent data sources or knowledge which were not used to build the model to establish external validity. If no validation on independent external data has been described, weaker forms of validations can help to discriminate between differently credible models. Are there indications that the model exhibits face validity to experts in the field? Such indications may comprise independent assessments of the model by other scientists, involvement of clinical experts in model building or a formal review process. Another indication of external validity is cross-validity to other studies by reflection upon results of modelling studies with a similar scope. 6. Has the model been externally validated to a reasonable extent? Guidance: Given the previously mentioned options of establishing external validity, assess to which extent the external validation procedure awards credibility to the model. Do the model predictions agree with external data? Does the model exhibit face validity in terms of plausibility and comprehensibility of

(Continued)

		generated results? Are study results comparable to those of other modelling studies? Has external validation been performed to a sufficient extent?
Validation (internal)	Caro 2014	7. Have indications of internal validity been reported? Guidance: Assess whether there has been a process of verifying the extent to which the mathematical calculations are consistent with the model's specifications, i.e. consider whether the modellers have shown that the model and its implementation work as intended. 8. Has the model been internally validated to a reasonable extent? Guidance: Assess the extent to which the consistency of mathematical calculations with the model's specifications is verified in the study. Possible examples of verifying internal consistency comprise analyses of whether the model behaves as expected in sensitivity analyses, verification that implemented code has been reviewed or analyses on simulated data which provide insight on whether a proposed model works as described. If a previously existing tool for the model was employed, this can also serve as some indication of internal validity.
Uncertainty	Caro 2014	9. Was there an adequate assessment of the effects of uncertainty? Guidance: Consider whether the robustness of results to alternative input parameter values or model assumptions was assessed sufficiently. Check whether stochastic uncertainty has been addressed appropriately if necessary, e.g. by a sufficient number of runs. Additionally, assess if the most urgent sources of uncertainty, which are likely to have considerable impact on results, were accounted for.
Transparency	Caro 2014	10. Is replication of model results possible with the materials provided by the authors? Guidance: Assess whether the description of the analyses (including model structure, input parameters, data sources and methods) is sufficiently detailed to allow for the replication of results. In particular, consider whether the code that was used to obtain the results is freely available and well documented.

Appendix 5. Characteristics of included studies: observational studies

Study ID	**Belmin 2020**
Study design	Historically controlled cohort study
Date and country of conduct	1 March-11 May 2020, France
Disease	COVID-19
NPI introduced in the LTCFs per domain	Domain: entry regulations Description: self-confinement of staff and residents Population targeted by the intervention: multiple (residents, staff, visitors) Level of implementation: LTCF

(Continued)

Other interventions implemented in LTCFs	Temperature and symptom screening (2 or 3 times a day); in France, visits by relatives to residents of nursing homes were banned by the Ministry of Health from 10 March-11 May 2020, and confinement of residents in their rooms was recommended during this period. In addition, new admissions were prohibited in the nursing homes with cases of COVID-19 among residents.
Characteristics of residents	Not reported
Type of LTCF	Nursing homes for elderly people (not further specified)
Other LTCFs characteristics	Mean number of residents: 73.5 (SD 27.6); mean number of staff: 46.7 (SD 22.7)
Details on level of community transmission	Varying by geographic area; overall mortality ranging from ≤ 9/100,000 to ≥ 25/100,000; incidence of COVID-19 among residents in nursing homes ranging from < 3% to > 10%
Outcome(s) per category	SARS-CoV-2 infections Description: proportion of cases (residents, staff) COVID-19-related deaths Description: proportion of deaths (residents) Contaminations of LTCFs Description: proportion of LTCFs with ≥ 1 COVID-19 case among residents Overall number of participants: 17 LTCFs; 1250 residents, 794 staff members Follow-up: self-confinement for varying periods (11-28 days first confinement + 14-21 days second confinement)
Notes	CoI: "None reported." Funding: not reported
Study ID	**Green 2021**
Study design	2-point prevalence survey
Date and country of conduct	April-May 2020, UK (Liverpool)
Disease	COVID-19
NPI introduced in the LTCFs per domain	Domain: contact-regulating and transmission-reducing measures Description: restriction of shared spaces Population targeted by the intervention: residents Level of implementation: LTCF
Other interventions implemented in LTCFs	Prior, all care homes in the city (Liverpool) had received extensive advice and support regarding infection prevention and control from local health and care partners. All care homes had closed to visitors prior to the study.
Characteristics of residents	Mean age of residents: 74 years; proportion of female residents: 60.4%
Type of LTCF	Care homes

(Continued)

Other LTCFs characteristics	Care home focus: 12 elderly residents; 5 residents with learning disabilities; 4 mixed clients; 4 residents with acute brain injuries; 3 elderly mentally infirm residents; 3 dementia residents; 3 residents with predominant mental health diagnoses
Details on level of community transmission	In April 2020, 56 out of 90 (62%) care homes in Liverpool previously had COVID-19 outbreaks
Outcome(s) per category	Contaminations of LTCFs Description: proportion of LTCFs with ≥ 1 COVID-19 case among residents Outbreaks in LTCFs Description: proportion of LTCFs with ≥ 1 COVID-19 case among residents Overall number of participants: 34 LTCFs; 818 residents Follow-up: 16-17 days
Notes	CoI: "None" Funding: "This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors."
Study ID	**Lipsitz 2020**
Study design	Prospective cohort study
Date and country of conduct	April 2020, USA (Massachusetts)
Disease	COVID-19
NPI introduced in the LTCFs per domain	Domain: contact-regulating and transmission-reducing measures Description: use of PPE Domain: outbreak control measures Description: separation of infected and non-infected Population targeted by the intervention: multiple (residents, staff) Level of implementation: LTCF
Other interventions implemented in LTCFs	All nursing homes in Massachusetts received a 28-point prevention checklist which included best practices in infection control (e.g. the use of PPE, staffing plans, clinical care, and communication with staff, residents, and families). Weekly webinars for LTCF managers and continuous Q&A support as well as resources for PPE, testing and staff were provided.
Characteristics of residents	Not reported
Type of LTCF	Nursing homes (not further specified)
Other LTCFs characteristics	Not reported
Details on level of community transmission	In April 2020, the nursing homes in Massachusetts became a hotspot for COVID-19 infections with > 10,000 confirmed cases. More than half of the state's deaths from the disease have occurred among residents and staff of these facilities.
Outcome(s) per category	SARS-CoV-2 infections

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	Description: change in mean weekly infection rates; change in odds of LTCFs with 0 infections relative to LTCFs with > 0 infections COVID-19-related deaths Description: change in mean weekly mortality rates; change in odds of LTCFs with 0 deaths relative to LTCFs with > 0 deaths Overall number of participants: 360 LTCFs Follow-up: 9 weeks
Notes	CoI: "The authors have declared no conflicts of interest for this article." Funding: "This work was supported by Grant 3U54AG063546-02S3 from the National Institute on Aging, the Massachusetts Executive Office for Health and Human Services, Massachusetts Senior Care Association, and Hebrew SeniorLife in Boston, Massachusetts. Lewis A. Lipsitz holds the Irving and Edyth S. Usen and Family Chair in Geriatric Medicine at Hebrew SeniorLife."
Study ID	**Lombardo 2021**
Study design	Retrospective cohort study
Date and country of conduct	24 March-27 April 2020, Italy
Disease	COVID-19
NPI introduced in the LTCFs per domain	Domain: outbreak control measures Description: isolation of infected cases Population targeted by the intervention: residents Level of implementation: LTCF
Other interventions implemented in LTCFs	All the nursing homes except for one suspended all visits from relatives/caregivers to the residents, provided alcohol-based hand sanitisers to their staff members and reported to monitor the temperature among residents and staff members twice a day
Characteristics of residents	Not reported
Type of LTCF	Nursing homes (care for elderly people with and without dementia)
Other LTCFs characteristics	Mean number of beds: 74.7 (SD 57.6); mean of bed per unit of staff: 1.8 (SD 1.1)
Details on level of community transmission	COVID-19 spread across Italian regions. In March the regions where the spreading rate of COVID-19 was higher were Lombardy (303.6 per 100,000), Emilia Romagna (190.3), PA Trento (185.2 per 100,000) and Marche (175.7), while Basilicata was the region with the lowest attack rate (2.8 per 100,000 habitants).
Outcome(s) per category	Contaminations of LTCFs Description: proportion of LTCFs with ≥ 1 COVID-19 relative to LTCFs with 0 COVID-19 among LTCFs Category: outbreaks in LTCFs Description: proportion of LTCFs with ≥ 1 COVID-19 relative to LTCFs with 0 COVID-19 among LTCFs Overall number of participants: 1356 LTCFs Follow-up: 1 February-5 May 2020 (start date of period examined until last day of collecting survey responses)

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Notes	CoI: "The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest." Funding: not reported
Study ID	**Reyné 2020**
Study design	Observational retrospective longitudinal study
Date and country of conduct	March-May 2020, France
Disease	COVID-19
NPI introduced in the LTCFs per domain	Domain: contact-regulating and transmission-reducing measures Description: mask wearing Domain: outbreak control measures Description: Separation of infected and non-infected Population targeted by the intervention: multiple (residents, staff) Level of implementation: LTCF
Other interventions implemented in LTCFs	Repeated testing for SARS-CoV-2 (rRT-PCR testing)
Characteristics of residents	Not reported
Type of LTCF	Nursing homes (not specified)
Other LTCFs characteristics	Staff per residents: 0.23–0.51; number of residents: 61-125
Details on level of community transmission	Not reported
Outcome(s) per category	Category: outbreaks in LTCFs Description: effect of factors in a general linear model on outbreak size in nursing homes Overall number of participants: 12 nursing homes; 930 residents; 360 staff members Follow-up: 6 weeks
Notes	CoI: "None of the authors report any potential conflicts." Funding: "This work was partly supported by the Occitanie region and the ANR (grant PhyEpi)."
Study ID	**Rolland 2020**
Study design	Case control study
Date and country of conduct	23 March-6 May 2020, France
Disease	COVID-19
NPI introduced in the LTCFs per domain	Domain: contact-regulating and transmission-reducing measures

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	Description: organising of the meals; cessation of group activities; containment in resident rooms; wearing masks; compartmentalisation of staff and residents; hygiene measures upon entry Population targeted by the intervention: multiple (residents, staff, visitors) Level of implementation: LTCF
Other interventions implemented in LTCFs	Not reported
Characteristics of residents	Not reported
Type of LTCF	LTCF (not specified)
Other LTCFs characteristics	Not reported
Details on level of community transmission	Not reported
Outcome(s) per category	Contaminations of LTCFs Description: odds of having ≥ 1 case(s) in a LTCF Outbreaks in LTCFs Description: odds of having ≥ 1 case(s) in a LTCF Overall number of participants: 124 LTCFs Follow-up: outcomes assessed between 23 March 23 and 6 May 2020
Notes	CoI: "The authors report no conflict of interest." Funding: not reported
Study ID	**Shallcross 2021**
Study design	Retrospective cohort study
Date and country of conduct	26 May-19 June 2020, UK (England)
Disease	COVID-19
NPI introduced in the LTCFs per domain	Domain: entry restrictions Description: admission restrictions (residents, visitors) Domain: contact-regulating and transmission-reducing measures Description: barrier nursing; cleaning frequency; staff use of PPE Domain: outbreak control measures Description: Isolation of infected cases; separation of staff caring for infected and non-infected Population targeted by the intervention: multiple (residents, staff, visitors) Level of implementation: LTCF
Other interventions implemented in LTCFs	Not specified; probably multiple

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Characteristics of residents	78.5% residents aged ≥ 65 years; 21.5% residents with dementia
Type of LTCF	LTCFs (providing dementia care or care to adults aged ≥ 65 years)
Other LTCFs characteristics	Mean number of residents: 32.2 (SD 17.3) Mean number of staff: 48.5 (SD 31.2)
Details on level of community transmission	Not reported
Outcome(s) per category	SARS-CoV-2 infections Description: proportion of cases (staff, residents); change in OR per number of new admissions to the LTCF relative to baseline Contaminations of LTCFs Description: proportion of LTCF with ≥ 1 case; change in OR per number of new admissions to the LTCF relative to baseline Outbreaks in LTCFs Description: proportion of LTCF with outbreak (≥ 1 case or ≥ 20 cases); change in OR per number of new admissions to the LTCF relative to baseline Overall number of participants: 5126 LTCFs Follow-up: 26 May-19 June 2020 (period of data collection)
Notes	CoI: "LS reports grants from the Department of Health and Social Care during the conduct of the study, and is a member of the Social Care Working Group, which reports to the Scientific Advisory Group for Emergencies. AH is a member of the New and Emerging Respiratory Virus Threats Advisory Group at the Department of Health. GH is an employee of Palantir Technologies UK, which has a paid contract with the Department of Health and Social Care to provide the data platform that was used for this study. All other authors declare no competing interests." Funding: "This work was funded by the UK Department of Health and Social Care. We acknowledge Rachel Williams and Anna Quigley from Ipsos MORI, who both led the survey fieldwork, and Julian Sandler from the Office for National Statistics, who supported construction of the tables. This report is independent research funded by the Department of Health and Social Care (COVID-19 surveillance studies). The views expressed in this publication are those of the authors and not necessarily those of the NHS or the Department of Health and Social Care."
Study ID	Telford 2020
Study design	Prospective cohort study
Date and country of conduct	March-May 2020, USA (Georgia)
Disease	COVID-19
NPI introduced in the LTCFs per domain	Domain: surveillance measures Description: mass screening conducted in response to a confirmed SARS-CoV-2 infection identified through symptom-based screening Population targeted by the intervention: multiple (residents, staff) Level of implementation: LTCF

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Other interventions implemented in LTCFs	Sites with positive SARS-CoV-2 test were given guidance and implementation support on general infection prevention and control measures to prevent further spreading
Characteristics of residents	Not reported
Type of LTCF	LTCF, defined as any facility that provides skilled nursing services, including nursing homes, and assisted living facilities
Other LTCFs characteristics	Not reported
Details on level of community transmission	During March–May 2020 in Fulton County, Georgia, > 50% of COVID-19–associated deaths occurred among LTCF residents, although these people represented < 1% of the population
Outcome(s) per category	SARS-CoV-2 infections Description: cases identified through mass testing (residents, staff); total cases identified (residents, staff) COVID-19-related deaths Description: number of deaths (residents, staff) Category: COVID-19-related hospitalisations Description: number of hospitalisations (residents, staff) Overall number of participants: 28 LTCF; 2868 residents; 2803 members of staff Follow-up: 4 weeks
Notes	CoI: “No potential conflicts of interest were disclosed.” Funding: “Dr. Gandhi is supported by NIH/NIAID K24AI114444.”
Study ID	**Telford 2021**
Study design	Case control study
Date and country of conduct	June-July 2020, USA (Georgia)
Disease	COVID-19
NPI introduced in the LTCFs per domain	Domain: entry restrictions Description: quarantine for new admissions; symptom-based entry screening Domain: contact-regulating and transmission-reducing measures Description: cleaning and environmental hygiene measures; cessation of resident indoor or outdoor activities (including physical therapy and gym); signage limiting maximum occupancy; monitoring of staff break room for adequate space; personal hygiene measures; mask and PPE use Domain: surveillance measures Description: temperature and screening log of staff, residents and visitors Domain: outbreak control measures Description: separation of infected and non-infected residents; separation of staff caring for infected and non-infected Population targeted by the intervention: multiple (residents, staff, visitors)

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	Level of implementation: LTCF
Other interventions implemented in LTCFs	General infection prevention and control measures (according to CDC recommendations) which were supervised by a LTCF Outbreak Response Team in collaboration with the Georgian Department of Public Health
Characteristics of residents	Not reported
Type of LTCF	LTCF (including nursing homes, skilled nursing facilities, and assisted living facilities)
Other LTCFs characteristics	Not reported
Details on level of community transmission	As of 29 July 2020, Fulton County, Georgia, which covers the city of Atlanta, had received reports of 1183 COVID-19 infections among residents from 45 LTCFs within its jurisdiction; 51% of COVID-19 deaths in Fulton County were attributed to LTCF residents
Outcome(s) per category	Outbreaks in LTCFs Description: odds of a high or low SARS-CoV-2 prevalence status (defined as above or below 39% prevalence, respectively) Overall number of participants: 24 LTCFs; 2580 residents Follow-up: June-July 2020 (period of data collection)
Notes	CoI: "None of the authors report a conflict of interest." Funding: "No specific funding was received for this work."
Study ID	**Vijh 2021**
Study design	Quasi-experimental, segmented regression analysis
Date and country of conduct	28 February-30 May 2020, Canada (British Columbia)
Disease	COVID-19
NPI introduced in the LTCFs per domain	Domain: outbreak control measures Description: multisectoral intervention implemented in LTCFs during an outbreak (including transmission and contact reduction measures, symptom-based screening, PCR-based testing, cohorting of residents and staff) Population targeted by the intervention: multiple (residents, staff) Level of implementation: LTCF
Other interventions implemented in LTCFs	A bundle of outbreak control measures was imposed by public health practitioners upon outbreak declaration
Characteristics of residents	Not reported
Type of LTCF	LTCF (not specified)
Other LTCFs characteristics	Number of residents: 107–210; number of staff: 108–259
Details on level of community transmission	British Columbia, 59% of COVID-19–related deaths were in LTCFs, compared to 75% in Canada overall and 30%–60% across Europe. As of May 2020, 35% (76 per 100,000 population) of all COVID-19 cases in the province were located in the Vancouver Coastal Health region.

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Outcome(s) per category	Category: SARS-CoV-2 infections Description: average daily change in the rate of COVID-19 during the post-intervention period (starting 14 days after the intervention) Overall number of participants: 7 LTCFs; 1144 residents; 1298 members of staff Follow-up: 14 days
Notes	CoI: "All authors report no conflicts of interest relevant to this article." Funding: "No financial support was provided relevant to this article."
Study ID	**Vijh 2021**
Study design	Longitudinal study
Date and country of conduct	March-September 2020, Canada (New Brunswick)
Disease	COVID-19
NPI introduced in the LTCFs per domain	Domain: entry restrictions Description: entry restrictions for visitors Population targeted by the intervention: residents Level of implementation: LTCF
Other interventions implemented in LTCFs	Group activities were halted; multiple strategies to keep families connected (e.g. window visits, video chats, outdoor visits)
Characteristics of residents	Mean age of residents: 81.4 (SD 11.5); proportion of female residents: 59.5%; diagnosis of dementia among residents: 55.6%; depression: 15.9%; delirium: 29.9%
Type of LTCF	Long-term care homes (not further specified)
Other context related factors	Mean number of beds: 59.6 (SD 20.9)
Details on level of community transmission	Provincially, there were no COVID-19 cases in New Brunswick LTCFs between March and September 2020
Outcome(s) per category	Category: adverse and other unintended mental or physical health outcomes Description: proportion of residents experiencing adverse effects (i.e. depression, delirium, behavioural problems) Overall number of participants: 7 LTCFs; 765 residents Follow-up: restrictions started between 12 March and 16 March 2020; data collected up to June 2020
Notes	CoI: "CM, MS, GH, NW, and JH are members of interRAI, a not-for-profit international scientific organization. George Heckman receives salary support from the Schlegel Research Chair in Geriatric Medicine." Funding: "A portion of this work was funded by a grant from Canadian Frailty Network."

CDC: Centers for Disease Control and Prevention; **LTCF:** long-term care facility; **NPI:** non-pharmaceutical intervention; **OR:** odds ratio; **PPE:** personal protective equipment; **Q&A:** question and answer

Appendix 6. Characteristics of included studies: mathematical modelling studies

Study ID	**Delaunay 2020**
Type of model (summary)	Homogeneous agent-Based SEIR-model
Geographical location (country)	Virtual setting; not specified
Key details of the mathematical model	Stochastic, agent-based SEIR- model of SARS-CoV-2 transmission of a hypothetical LTCF with n = 280 residents and staff members. All individuals are susceptible at baseline and 1 infectious case of SARS-CoV-2 is randomly imported into the LTCF during the first 2 weeks. Individuals are assumed to mix homogeneously and can acquire SARS-CoV-2 from an individual outside the LTCF (e.g. through visitors or staff members in contact with the community) or from an individual inside the LTCF. The model tracks individual disease status daily (with fixed time steps) until a first case is diagnosed. For each scenario, 1000 iterations were performed.
Representation of LTCFs and population in the model	Population consists of 280 agents (residents and staff) in the facility and additional agents representing outside visitors. Staff members and residents can get infected in the community, based on a probability depending on the community burden of SARS-CoV-2. No additional differing characteristics beyond status as resident or staff member is assumed and at no point in the model are these actually treated differently. Model assumes homogeneous mixing within the LTCF.
Profile of LTCF residents in the model	Not further specified
Community transmission and infection risk outside the LTCF	Assumption of a community transmission of 50 cases per 100,000 people per 14 days in the baseline scenario
Context-related factors regarding institutional risk factors for infection and outbreaks within LTCFs	Not specified
Description of SARS-CoV-2 in model	Assumption of R0 as 3 inside and outside the LTCF. Infectious period of 7 days. Sensitivity analysis of R0 assumed as 1.5, 2.0 and 5.0
Notes	CoI:“The authors have no conflict of interest to disclose.” Funding:“This research did not receive any funding from agencies in the public, commercial, or not-for-profit sectors.”
Study ID	**Holmdahl 2021**
Type of model (summary)	Agent-Based SEI(AP)R-type-model
Geographical location (Country)	Virtual setting: model parameters are chosen to broadly describe LTCFs in Massachusetts (USA)
Key details of the mathematical model	LTCF is modelled with residents and staff agents, who interact on a specified network structure. Model accounts for asymptomatic/presymptomatic (AP) cases. Time-dependent viral load is introduced, allowing for different levels of infectiousness of agents and to allow a comparison between antigen and PCR tests. Symptom-based isolation of individuals is included in addition to testing.

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	Staff can introduce infection into LTCF via community infection. Each scenario is simulated in one LTCF across 100 iterations.
Representation of LTCFs and population in the model	Model of 100 agents classified as residents and 100 agents classified as staff members; both with different rates of contacts among each other, based on contact rates derived from empirical data from a Massachusetts network of nursing homes. The model assumes six contacts (at risk of an infection occurring) between residents and staff and 0 contacts between residents who are not roommates (in a sensitivity analysis: 2 contacts per resident per day). Staff members have constant daily risk of infection from the community.
Profile of LTCF residents in the model	Not further specified
Community transmission and infection risk outside the LTCF	Daily probability of infection from the community (staff): 0.005%
Context - related factors regarding institutional risk factors for infection and outbreaks within LTCFs	Entry restrictions for visitors: no infections possible through visitors Strong contact reduction among residents (e.g. closing of public spaces) Model assumes that 2 residents share 1 room.
Description of SARS-CoV-2 in model	Viral load depending on course of infection: Latency period of 3-5 days, followed by a rapid increase in viral load. Symptoms begin after 2 days of increasing viral load. Peak of viral load occurs 2-5 days after the end of the latency period and declines afterward. Mean peak viral load in infected individuals assumed as: 10^8 copies/mL; with viral load threshold for infectiousness assumed as 10^4 copies/mL and for high infectiousness as 10^7 copies/mL. Assumption of (temporary) immunity after infection
Notes	CoI: “MJM has received ad hoc speaking fees from Abbott Diagnostics and Roche Diagnostics.” Funding: “MJM is supported by the U01 Serological Centers of Excellence Grant. MJM and JH are supported by the DP5 NIH Director’s Award.”
Study ID	**Knock 2021**
Type of model (summary)	Stochastic, compartmental SEI(AP)R-type-transmission-dynamic model
Geographical location (Country)	Model based on empirical data from England for the period March-December 2020
Key details of the mathematical model	Stochastic, compartmental SEI(AP)R-type-transmission-dynamic,model. Model focuses on depicting the general development of the disease in the population, including separate compartments for LTCF residents and staff. Model features a wide variety of disease states based on a SEIR paradigm but extended by many other states such as hospitalised states and ICU, asymptomatic, tested and dead. These are additionally stratified by regions in the UK and different age classes with a specific LTCF residents and LTCF staff class. Dynamics are generated following a stochastic compartmental approach, which was informed by an extensive variety of data sources. The contact matrix within the general population, of the staff members, and the residents is based on an age-stratified contact matrix (see population).
Representation of LTCFs and population in the model	LTCFs are represented on the level of compartments stratified by age. LTCF residents and LTCF workers pose 2 additional compartments, representing regional average behaviour. Transmission between the general population and care home workers was assumed to be similar to that within the general population stratified by age group, accounting for the average age of care home workers. Transmission between the general population and care home residents was assumed to be similar to that between the general population and the 80+ age group, adjusted by a reduction factor. These represent contact between visitors from the general community and the care home res-

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	idents. Care home workers and residents constitute a single group in the model. Thus, specific transmission dynamics within each care home are not captured, but rather an average mixing between residents and workers in the regional care home sector as a whole is reflected.
Profile of LTCF residents in the model	The care home residents were drawn from the 65+ year-old general population, such that 5% were aged 65-69, 5% aged 70-74, 15% aged 75-79 and 75% aged 80+.
Community transmission and infection risk outside the LTCF	Model reflects the course of the disease in England in 2020; this includes the impact of population - wide NPIs, such as lock down and general contact reductions in the population of England.
Context - related factors regarding institutional risk factors for infection and outbreaks within LTCFs	Not reported
Description of SARS-CoV-2 in model	R0 was estimated as 2.9 (95% CrI 2. 8 - 3.1), adapted through NPIs in the general population. Viral dynamics are characterised by a large set of differential equations and states with various transmission rates.
Notes	CoI: not reported Funding: not reported
Study ID	**Love 2021**
Type of model (summary)	Agent-based model SEI(AP)RD model with stochastic contact network
Geographical location (Country)	Virtual setting; parts of the model (e.g. staff-to-resident ratio) reflecting the USA
Key details of the mathematical model	Agent-based model SEI(AP)RD model with stochastic contact network Model accounts for different SEIR(AP)D disease states and additionally for mild/severe cases. Study analyses effect of vaccination and NPIs. Patients and staff have different changing contact matrices with daily network type structure. There is isolation upon symptoms, random infectiousness, different effects of vaccines and interaction with the community. Each simulation ran for 100 days with discrete daily steps.
Representation of LTCFs and population in the model	100 patients and 51 staff members as agents in hypothetical LTCF
Profile of LTCF residents in the model	Not further specified
Community transmission and infection risk outside the LTCF	Not further specified
Context - related factors regarding institutional risk factors for infection and outbreaks within LTCFs	Not further specified
Description of SARS-CoV-2 in model	Not further specified
Notes	CoI: “Drs. Angulo, Mclaughlin, Shea, and Swerdlow reported being employed by Pfizer Vaccines.” Funding: “This work was supported by Pfizer. Pfizer Inc. reviewed this manuscript and approved the decision to submit the manuscript for publication.”

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Study ID	**Nguyen 2020**
Type of model (summary)	Agent-based model SEI(AP)RD model with stochastic contact network
Geographical location (Country)	Virtual setting; model reflecting LTCF in Scotland
Key details of the mathematical model	Agent-based stochastic model with disease states in a basic SEIR model. Susceptible individuals may acquire an infection after an exposure, and enter either a symptomatic or asymptomatic disease state (same level infectiousness) after a presymptomatic stage. Symptoms can be either mild or severe and require hospitalisations. Individuals either recover (and remain immune) or die. The number of contacts for patient-patient, patient-staff, staff-staff contacts are randomly drawn for each individual from a Poisson distribution. Deceased residents are replaced by new admissions. Infections can occur in the LTCF through importation of infected residents upon admission (from hospitals and the community), from staff members or from visitors; with their probability of infection depending on an assumed COVID-19 prevalence in the community. Transmission events can occur through contacts made between susceptible agents and infectious agents, determined by the infection probability per contact. Model starts with 1 random resident infected at the beginning of the simulation. Results are simulated under various sets of parameters (mainly presented are the scenarios for the base case parameters). Each simulation was run 300 times.
Representation of LTCFs and population in the model	LTCF consists of 80 residents and 72 staff members, with 2 units of 33 and 32 staff members respectively (16 and 15 on duty per day respectively) and 40 residents. In addition, there are 7 additional staff members who are shared across the 2 units. Residents and staff are distinguished by their contact structure and also some individual properties. Contacts are drawn from a Poisson distribution with each staff member having a mean number of 7.3 contacts with other staff members, 16.2 contacts with residents, and 5.0 contacts with visitors per day. Residents are assumed to have a mean number of 3.9 contacts with other residents and 1.0 visitors per day. Probability of contact of residents from the other unit is assumed to occur in 20% of contacts.
Profile of LTCF residents in the model	Not specified in detail; based on LTCF population in Scotland
Community transmission and infection risk outside the LTCF	Infection prevalence in the facility: 0.02 Infection prevalence in the community: 0.05
Context - related factors regarding institutional risk factors for infection and outbreaks within LTCFs	Model assumes that only single rooms are available in the facility
Description of SARS-CoV-2 in model	Probability of infection upon contact between susceptible individual and infectious individual: 2% Assumed duration of prodromal period: 1.2 days; of incubation period: 3.2 days, and of infectious period after developing symptoms: 2 days Probability of developing symptoms upon infection assumed to be 90% for 80+ year-old residents, as 85% for 70-79 year-old residents, and of 70% for staff members. Probability of developing severe symptomatic disease assumed as 28% for 80+ year-old residents, as 25% for 70-79 year-old residents, and drawn from a uniform distribution ranging from 1% to 17% for staff members. Infection fatality rate assumed as 11% for 80+ year-old residents, as 6% for 70-79 year-old residents, and drawn from a uniform distribution ranging from 0.03% to 2.2% for staff members.
Notes	CoI: " All authors declare no potential conflicts of interest related to this article." Funding: "This work was funded by the University of Strathclyde as part of L.L.K.N.'s doctoral project."
Study ID	**See 2020**

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Type of model (summary)	Simple Reed-Frost transmission model
Geographical location (Country)	Virtual setting; parts of the model (e.g. staff-to-resident ratio) reflecting the USA
Key details of the mathematical model	Reed-Frost model represents a discrete number of generations of infected individuals in the population and transmission probability between generations depends only on reproduction number (and susceptible individuals). Testing (depending on a probability reflecting the sensitivity of the tests and after completion of the turnaround time for the results) or development of symptoms ("detection") eliminates the infected individual incorporated in the model by mitigation of the reproduction number. For each testing strategy, a mitigated reproduction number was calculated based on assumption on parameters of SARS-CoV-2 and characteristics of the testing strategy; which was used to compare the outbreak size against the outbreak size without the testing strategy (using the non-mitigated reproduction number) . The Reed-Frost transmission model is by definition stochastic and describes a homogeneous population. Based on the assumed reproduction number and population assumptions, the mean number of cases per outbreak was assumed as 50 cases.
Representation of LTCFs and population in the model	Population is represented by 86 residents and 129 healthcare personnel agents with homogeneous transmission properties between them. They differ in the fact that residents do not interact with the community and cannot introduce the infection into the facility.
Profile of LTCF residents in the model	Not specified
Community transmission and infection risk outside the LTCF	Not specified
Context - related factors regarding institutional risk factors for infection and outbreaks within LTCFs	Not specified
Description of SARS-CoV-2 in model	The effective R was assumed to be 1.4 within the clinic; taking infection control measures in place into account. Assumed generation time of 50%. Infectiousness was described through a Gamma density function in order to reflect 50% of transmissions occurring from pre- and asymptomatic cases. Infectivity during pre-symptomatic stage compared to symptomatic stage: 50% Proportion of pre- and asymptomatic infections assumed at 40%, with their infectiousness assumed to be reduced by 25%.
Notes	CoI: "None." Funding: "This work was funded by the Centers for Disease Control and Prevention."
Study ID	**Smith 2020a (main model of a 170-bed LTCF)**
Type of model (summary)	Agent-based model SEI(AP)RD model with stochastic contact network
Geographical location (Country)	Virtual setting: structure of the LTCF and contact network built to represent French LTCFs
Key details of the mathematical model	The model is based on an empirical study of a LTCF in which contacts were tracked by sensors over the course of several months, which was used to estimate contact rates of the different groups of agents. In the transmission model, susceptible patients and staff could become infected with SARS-CoV-2 upon contact, with the probability of transmission per infectious contact depending on the time of contact and assumptions on the infectiousness. Different surveillance strategies under the

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	premise of limited test resources are modelled based on information of the extended SEIR model states, including symptom-based testing. It was assumed that 1.1% per day of individuals in the facility would show COVID-19-like symptoms of respiratory infections without being infected by SARS-CoV-2; 20% of those would show severe symptoms. It is assumed that once weekly either (a) one new infected patient is admitted or one member of staff is infected in the community. Each scenario is simulated in one LTCF across 100 iterations.
Representation of LTCFs and population in the model	The population consists of agents in the roles of residents (n = 170) and staff (n = 410). The population is chosen to equal a French rehabilitation facility with 5 wards (3 x Neurology, Nutrition, Geriatrics), for which the contact structure has been investigated in another study. This empirical study tracked residents and staff with sensors over the course of several months. Employing this contact structure, a stochastic COVID transmission model has been built on top which utilises the highly time-resolved contact data to simulate transmission dynamics reflecting the facility. The wards are primarily connected through agents assigned the role of agents. The population consists of 170 residents (30-38 residents per ward), 240 staff members (17-39 per ward and an additional 90 not assigned to a specific ward) present each week with the staff characterised by different occupations. The staff member agents are either assigned the role of health care worker (n = 183) or ancillary staff (n = 57). The different populations are represented by different contact networks. Healthcare workers had more distinct contacts with other individuals (on average 14.3/day) than patients (11.2/day) but had a shorter cumulative duration of time spent in contact with others (15 minutes/day) than patients (32 minutes/day). Compared to other wards, contacts were fewest (8.6 distinct contacts per individual per day) and longest (47 cumulative minutes/day) in the geriatric ward.
Profile of LTCF residents in the model	Not specified; contact network based on a rehabilitation facility. Likely, age structure is younger than with an aged-care facility; relation to nursing homes specialised in younger individuals living with disabilities is unclear.
Community transmission and infection risk outside the LTCF	Not specified
Context - related factors regarding institutional risk factors for infection and outbreaks within LTCFs	Not specified; likely basic infection control measures in place, reducing the R0 to 3 as assumed in the model
Description of SARS-CoV-2 in model	Probability of transmission per minute was assumed at 0.14% (ranging from 0.07% to 0.28% across different analyses) spent in contact with a susceptible individual, reflecting an R(T) of 3 (ranging from 1.5 to 6). We further set a saturation threshold at 1 hour of contact, such that the per-contact transmission probability was at most 8.3% per contact between any two individuals. The infectious period was assumed to be 9 days. Clinical progression of COVID-19 was characterised by: (i) a non-infectious exposed period of 2-5 days, (ii) an infectious pre-symptomatic period of 1-3 days, (iii) an on-average 7-day infectious 'symptomatic' period with 3 levels of symptom severity (severe, mild or asymptomatic), and (iv) eventual recovery with full immunity. It was assumed that 70% of individuals showed symptoms and 20% of those showing SARS-CoV-2 like symptoms would show severe symptoms.
Notes	CoI: “LO reports grants from Pfizer, outside the submitted work. All other authors report no competing interests.” Funding: “The work was supported directly by internal resources from the French National Institute for Health and Medical Research, the Institut Pasteur, the Conservatoire National des Arts et Métiers, and the University of Versailles– Saint-Quentin-en-Yvelines/University of Paris-Saclay. This study received funding from the French Government’s “Investissement d’Avenir” programme, Laboratoire d’Excellence “Integrative Biology of Emerging Infectious Diseases” (Grant ANR-10-LABX-62- IBEID). DS is supported by a Canadian Institutes of Health Research Doctoral Foreign Study Award (Funding Reference Number 164263) as well as the French government through its National Research Agency project SPHINX-17-CE36-0008-01. KP is supported by the National Institute for Health Research (NIHR) Health Protection Research Unit in Healthcare Associated Infections

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	and Antimicrobial Resistance at the Smith et al. BMC Medicine (2020) 18:386 Page 13 of 16 University of Oxford in partnership with Public Health England (grant number NIHR200915)."
Study ID	**Smith 2020a (model for: 30-bed geriatric LTCF)**
Type of model (summary)	Agent-based model SEI(AP)RD model with stochastic contact network
Geographical location (Country)	Virtual setting; structure of the LTCF and contact network built to represent France
Key details of the mathematical model	Agent-based model SEI(AP)RD model with stochastic contact network. Same study as the main analysis of Smith 2020, but modelled for a smaller LTCF with an older composition of residents requiring on average more support; operationalised through a higher number of contacts per day (8.0 daily patient-patient contacts and 8.3 daily patient-staff contacts) The model is based on an empirical study of a rehabilitation hospital, in which contacts were tracked by sensors over the course of several months, which was used to estimate contact rates of the different groups of agents. In the transmission model, susceptible patients and staff could become infected with SARS-CoV-2 upon contact, with the probability of transmission per infectious contact depending on the time of contact and assumptions on the infectiousness. Different surveillance strategies under the premise of limited test resources are modelled based on information of the extended SEIR model states, including symptom-based testing. It was assumed that 1.1% of individuals in the facility would show COVID-19-like symptoms of respiratory infections without being infected by SARS-CoV-2; with 20% of those would be showing severe symptoms. It is assumed that once weekly either (a) one new infected patient is admitted or one member of staff is infected in the community. Each scenario is simulated in one LTCF across 100 iterations.
Representation of LTCFs and population in the model	The population consists of agents in the roles of residents (n = 30) and staff (approximately n = 45; exact number unclear). The model intends to reflect a small geriatric LTCF with 30 beds, with contact patterns modelled after the geriatric ward of a French rehabilitation facility, for which contact structure has been investigated in another study. This empirical study tracked residents and staff with sensors over the course of several months. Employing this contact structure, a stochastic COVID transmission model has been built on top which utilises the highly time-resolved contact data to simulate transmission dynamics reflecting the facility. The wards are primarily connected through agents assigned the role of agents. The population consists of 30 residents, 26 staff members on the ward and an additional set of staff members (approx. 19, but not clearly specified). The staff member agents are either assigned the role of healthcare worker or ancillary staff, with different contact networks. It was assumed that there would be: 8.0 daily patient-patient contacts and 8.3 daily patient-staff contacts with contact lengths of 47 cumulative minutes per day.
Profile of LTCF residents in the model	Not specified; modelled after the geriatric ward of a rehabilitation facility and contact rates were comparable to an LTCF for senior citizens in Paris, likely similar to an aged-care facility
Community transmission and infection risk outside the LTCF	Not specified; but as model focuses on outbreak detection, not essential for the model
Context related factors regarding institutional risk-factors for infection and outbreaks within LTCFs	Not specified; likely basic infection control measures in place, reducing the R0 to 3 as assumed in the model
Description of SARS-CoV-2 in model	Probability of transmission per minute was assumed at 0.14% (ranging from 0.07% to 0.28% across different analyses) spent in contact with a susceptible individual, reflecting an R(T) of 3 (ranging from 1.5 to 6). We further set a saturation threshold at 1 hour of contact, such that the per-contact transmission probability was at most 8.3% per contact between any 2 individuals. The infectious period was assumed to be 9 days. Clinical progression of COVID-19 was characterised by: (i) a non-infectious exposed period of 2-5 days, (ii) an infectious pre-symptomatic period of 1-3 days, (iii) an

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	on-average 7-day infectious 'symptomatic' period with 3 levels of symptom severity (severe, mild or asymptomatic), and (iv) eventual recovery with full immunity. It was assumed that 70% of individuals showed symptoms and 20% of those would show severe symptoms.
Notes	CoI: "LO reports grants from Pfizer, outside the submitted work. All other authors report no competing interests." Funding: "The work was supported by the French National Research Agency (ANR) project MOD-COV (ANR-20-COVI-0071). DS is supported by a Canadian Institutes of Health Research Doctoral Foreign Study Award (Funding Reference Number 164263) as well as the ANR project SPHINX-17-CE36-0008-01."
Study ID	**Smith 2020b**
Type of model (summary)	Agent-based model SEI(AP)RD model with stochastic contact network
Geographical location (Country)	Virtual setting: structure of the LTCF and contact network build to represent France
Key details of the mathematical model	Agent-based model SEI(AP)RD model with stochastic contact network. The model is based on an empirical study of a LTCF in which contacts were tracked by sensors over the course several months, which was used to estimate contact rates of the different groups of agents. In the transmission model, susceptible patients and staff could become infected with SARS-CoV-2 upon contact, with the probability of transmission per infectious contact depending on the time of contact and assumptions on the infectiousness. Different surveillance strategies under the premise of limited test resources are modelled based on information of the extended SEIR model states, including symptom-based testing. It was assumed that 1.1% of individuals in the facility would show COVID-19 like symptoms of respiratory infections without being infected by SARS-CoV-2; with 20% of those would be showing severe symptoms. Model intends to reflect the situation after national or religious holidays (here: Christmas). In addition, to the baseline scenario of the weekly introduction of either (a) one new infected patient or (b) staff member from the community, 0-3 additional holiday-associated cases are introduced (each with an average age of infection of 5 days (1-8 days). Each scenario is simulated in 1 LTCF across 10,000 iterations.
Representation of LTCFs and population in the model	The population consists of agents in the roles of residents (n = 170) and staff (n = 410). The population is chosen to equal a French rehabilitation facility with 5 wards (3 x Neurology, Nutrition, Geriatrics), for which contact structure has been investigated in another study. This empirical study tracked residents and staff with sensors over the course of several months. Employing this contact structure, a stochastic COVID transmission model has been built on top which utilises the highly time-resolved contact data to simulate transmission dynamics reflecting the facility. The wards are primarily connected through agents assigned the role of agents. The population consists of 170 residents (30-38 residents per ward), 240 staff members (17-39 per ward and an additional 90 not assigned to a specific ward) present each week with the staff characterised by different occupations. The staff member agents are either assigned the role of healthcare worker (n = 183) or ancillary staff (n = 57). The different populations are represented by different contact networks. Healthcare workers had more distinct contacts with other individuals (on average 14.3/day) than patients (11.2/day) but had a shorter cumulative duration of time spent in contact with others (15 minutes/day) than patients (32 minutes/day). Compared to other wards, contacts were fewest (8.6 distinct contacts per individual per day) and longest (47 cumulative minutes/day) in the geriatric ward.
Profile of LTCF residents in the model	Not specified; contact network based on a rehabilitation facility. Likely, age structure is younger than with an aged-care facility; relation to nursing homes specialised in younger individuals living with disabilities is unclear

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Community transmission and infection risk outside the LTCF	Model intends to reflect the post-holiday phase, reflecting an assumed increased risk of SARS-CoV-2 infections of 10% for staff members and 50% of patients returning to the LTCF after the holidays.
Context - related factors regarding institutional risk factors for infection and outbreaks within LTCFs	Basic infection control measures in place, reducing the R0 to 3 as assumed in the model. In addition, 20% of residents and staff are considered immune and a reduced per-contact transmission risk of −20% is assumed, to reflect increased awareness and PPE practices.
Description of SARS-CoV-2 in model	Probability of transmission per minute was assumed at 0.14% (ranging from 0.07% to 0.28% across different analyses) spent in contact with a susceptible individual, reflecting an R(T) of 3 (ranging from 1.5-6). We further set a saturation threshold at 1 hour of contact, such that the per-contact transmission probability was at most 8.3% per contact between any two individuals. The infectious period was assumed to be 9 days. Clinical progression of COVID-19 was characterised by: (i) a non-infectious exposed period of 2-5 days, (ii) an infectious pre-symptomatic period of 1-3 days, (iii) an on-average 7-day infectious 'symptomatic' period with 3 levels of symptom severity (severe, mild or asymptomatic), and (iv) eventual recovery with full immunity. It was assumed that 70% of individuals showed symptoms and 20% of those would show severe symptoms.
Notes	CoI: “LO reports grants from Pfizer, outside the submitted work. All other authors report no competing interests.” Funding: “The work was supported by the French National Research Agency (ANR) project MOD-COV (ANR-20-COVI-0071). DS is supported by a Canadian Institutes of Health Research Doctoral Foreign Study Award (Funding Reference Number 164263) as well as the ANR project SPHINX-17-CE36-0008-01.”
Study ID	**Tsoungui 2021**
Type of model (summary)	Extended deterministic SEIR-type model
Geographical location (Country)	Virtual setting: model parameters are chosen to broadly describe Germany. Additional analyses were done for the USA (not included in this study).
Key details of the mathematical model	Deterministic dynamic model (CovidSim 1.1) with parameters adapted to describe German LTCFs. The model includes 3 population groups with different contact patterns from each other (see population). These are further divided into susceptible, infected, recovered, or dead individuals, with different stages for the infectious individuals (in latency period, in prodromal period, fully contagious period and late infective period). Within the model, susceptible individuals acquire infections through contacts with individuals in one of the infectious stages upon occurring contacts.
Representation of LTCFs and population in the model	Individual states for 3 population subgroups: general population, employees in all LTCFs and all residents in LTCFs (described as an immobile risk group). The model parameters were chosen to describe population sizes in Germany. Assumption of 50 daily contacts with potential of infection for staff and of 30 contacts for residents, both including contacts with the general population, (other) staff members, and (other) residents The model does not further disaggregate the agents into individual LTCFs. The overall population in the model are assumed as 700,000 LTCF residents, 500, 000 LTCFs and 83 million individuals in the general population.
Profile of LTCF residents in the model	Not further specified; assumed to have higher mortality than general population
Community transmission and infection risk outside the LTCF	Assumption: a first case was introduced in Germany in February (peak value for R0 was assumed to be December)

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Context - related factors regarding institutional risk factors for infection and outbreaks within LTCFs	Not specified
Description of SARS-CoV-2 in model	Assumption of R0 of 3.4 on average for Germany with strong seasonal variation and peak in December. Assumption of an infection fatality rate of 20% for LTCF residents and 1.5% for LTCF staff
Notes	CoI: not reported Funding: not reported
Study ID	**Vilches 2020**
Type of model (summary)	Agent-based SEI(AP)RD model
Geographical location (Country)	Virtual setting; model assumption s based on LTCFs in Ontario, Canada
Key details of the mathematical model	Agent-based SEI(AP)RD model LTCF with demographic data based on real-world data of LTCFs in Ontario Agents in the model are assigned different roles (resident, direct care providers, dietary staff and housekeeping personnel) which have different numbers of contacts among other agents per day. The model includes 3 working shifts of morning, evening, and night, each covering 8 hours of daily interactions. In the transmission model, agents who are susceptible pass through the stages latently infected (not yet infectious); asymptomatic (and infectious); pre-symptomatic (and infectious); symptomatic with either mild or severe/critical illness; and recovered or dead. Model assumes that infection is introduced into the LTCF through infected staff during the silent asymptomatic or pre-symptomatic stages of disease, with a probability of infection outside the LTCF of 0.05%-0.1%, which is considered prior to the start of each shift. Infections occur upon contact, depending on the stage of the infection (highest for pre-symptomatic stage, lowest for asymptomatic stage) Isolated staff and hospitalised residents are removed from the LTCF, isolated cases were limited to contact only to agents with the role of direct healthcare providers. It is assumed that those who recover are temporarily immune.
Representation of LTCFs and population in the model	The population consists of agents in the role of residents (n = 120) and staff (n = 68). Population demographic, age structure, staff-to-resident ratio, distribution of rooms, and occupancy was informed by real world LTCF-data, primarily from Ontario, Canada. LTCF in the model has a total of 120 residents assigned to 48 single and 36 double-occupancy rooms. The model includes 68 agents in the role of staff members (aged 20-64 years; with 38% of those in the age group 50-64 having comorbidities). Mean number of 6.8 resident-to-resident contacts per resident per day. Daily numbers of contacts between residents and direct care providers varied from 6 to 9.
Profile of LTCF residents in the model	Resident age structure: age 50-64 (6.6%), 65-74 (11.4%), 75-84 (27.3%), 85-94 (43.9%), and 95+ (10.8%)
Community transmission and infection risk outside the LTCF	Probability of infection in the community per staff member per shift: 0.05%-0.1%
Context - related factors regarding institutional risk factors for infection and outbreaks within LTCFs	Model assumes visiting restrictions to be in place during outbreaks, therefore no visitors are included in the model. Symptomatic staff members do not enter the LTCF and are put in quarantine for 14 days (until recovery). Residents with symptomatic disease and their roommates, were immediately isolated upon symptom onset within the LTCF; cohorting of care providers (agents in the role of personal support workers only interact with a predetermined group of 9 residents during morning and evening shift, and 20 during night shift; agents in the role of nurses only interact with a predetermined group of 30 residents during morning and evening shift, and 60 during night shift). Mask-

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	wearing by all staff members during shift (baseline reduced transmission probability upon contact) and wearing N95 masks when in contact with isolated residents (transmission probability reduced by 95%).
Description of SARS-CoV-2 in model	The incubation and pre-symptomatic periods were sampled from Log-Normal and Gamma distributions with mean values of 5.2 and 2.3 days, respectively, with an infectious period that was sampled from a Gamma distribution with a mean of 5 days. The infectious period post-symptom onset was also sampled from a Gamma distribution with a mean of 3.2 days. Symptomatic cases had an age-dependent probability of developing mild or severe/critical illness. The probability of asymptomatic infection was 33% for staff members and younger residents, and declined to 19% for residents aged 70+ years. Among residents, 80% with symptomatic infections developed severe cases and 7% to 18% required hospitalisation. Case fatality rate was 0.21% for staff members and assumed ranging from 8.4% to 35.4% for residents, depending on age. The infectiousness was assumed to be highest in the pre-symptomatic stage, at a transmission probability per contact at 4.34% and with the risks of the other stages relative to the pre-symptomatic stage being 0.26, 0.44, and 0.89 for the asymptomatic, mild symptomatic, and severe symptomatic stages. It is assumed that those who recover are temporarily immune.
Notes	CoI: "Dr. Joanne M. Langley reports that her institution has received funding for research studies from Sanofi Pasteur, GlaxoSmithKline, Merck, Janssen and Pfizer. Dr. Joanne M. Langley also holds the CIHR-GSK Chair in Pediatric Vaccinology at Dalhousie University. Other authors declare no competing interests." Funding: "Seyed Moghadas: CIHR (OV4 — 170643), COVID-19 Rapid Research; Natural Sciences and Engineering Research Council of Canada; and Canadian Foundation for Innovation. Alison Galvani: NSF (RAPID - 2027755), NIH (1RO1AI151176-01). Thomas N. Vilches: São Paulo Research Foundation (FAPESP), grant 2018/24811-1. Lauren Cipriano: Society for Medical Decision Making COVID-19 Decision Modeling Initiative funded by the Gordon and Betty Moore Foundation through Grant GBMF9634 to Johns Hopkins University and a Western University Catalyst Research Grant. The funders had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; preparation, review, or approval of the manuscript; and decision to submit the manuscript for publication."
Study ID	**Wilmink 2020**
Type of model (summary)	Extended SEIR-type model
Geographical location (Country)	Virtual setting: model parameters are chosen to represent a LTCF in the USA
Key details of the mathematical model	Deterministic dynamic model with multiple states to simulate the transmission of SARS-CoV-2 with a LTCF with digital contract tracing in place
Representation of LTCFs and population in the model	1 LTCF with 80 residents and 40 employees considered
Profile of LTCF residents in the model	Not further specified
Community transmission and infection risk outside the LTCF	Not further specified
Context - related factors regarding institutional risk factors for infection and outbreaks within LTCFs	Quarantine was only assumed in case the individuals were in the symptomatic infectious state. Measures were introduced with a certain time delay, symptom-based mapping (1 day), manual contact tracing (2 days), swab PCR (1 day), and digital contact tracing (0.1 days)
Description of SARS-CoV-2 in model	The model assumed a latency period of 3–5 days with an adjunct incubation period of 2-14 days. The model included 2 states of infected individuals: pre-symptomatic and symptomatic infectious.

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	The transmission rates ($ß_p$ & $ß_s$) for these states were determined as average contacts per day to the facility: $ß_p$ = 0.52 day^{-1} and $ß_s = ß_p/2$ day^{-1}, respectively. The model assumes a death rate of 0.001-0.1
Notes	CoI: "GW, IS, DM, JG, GZ, SS, and SM are employees of CarePredict. HF serves as an advisor to CarePredict corporation." Funding: not reported

AP: asymptomatic/presymptomatic; **ICU:** intensive care unit; **LTCF:** long-term care facility; **NPI:** non-pharmaceutical intervention; **R0:** reproduction number

Appendix 7. Risk of bias of observational studies assessed with ROBINS-I

Study ID	**Belmin 2020**	
Intervention categories	1. Self-confinement of staff with residents	
Outcomes	1. Infections among residents 1. Infections among staff members 2. Contamination of the facilities 5. Deaths among residents	
Effect	Implementation and adherence to the measure	
Overall rating	**Serious**	At least one known important confounding domain was not appropriately measured and/or not controlled for. There is a risk of bias due to differences in additional infection-control measures beyond the measure of interest, which were not adequately accounted for in the analysis. Furthermore, selection into the study may have been related to intervention and outcome (but likely not strong enough to affect the direction of effect across all facilities). There were deviations from the intended interventions (in terms of implementation and/or adherence), but their impact on the direction of effect of the outcome is expected to be slight. It cannot be ruled out that there could have been selection effects, where LTCFs which were "more successful" in protecting the residents were selected into the study, which could have been more likely to have had implemented the intervention. These biases could favour the intervention group.
What is the overall predicted direction of bias for this outcome?	Unpredictable	Different bias domains may bias the effect in favour of the measure and towards the null.
Bias due to confounding	Serious	*At least one known important confounding domain was not appropriately measured, or not controlled for.* There is a risk that LTCFs with more dedication or resources to protect residents had implemented the measure. These LTCFs could have been more likely to have additional protective factors in place than those LTCFs which did

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		not engage in self-confinement (e.g. different levels of staffing; different structure of the facility). Similarly, the intervention group may have been less affected by risk factors for outbreaks and infections (e.g. high levels of community burden) than the LTCFs in the control group. The study does not adequately control for this risk of bias due to confounding, which could explain the effect. An imbalance of these risk and protective factors or underlying interventions could explain the association between intervention and outcome.
Bias in selection of participants into the study	Moderate	*Selection into the study may have been related to intervention and outcome (but likely not strong enough to affect the direction of effect across all facilities) and this was not adjusted for in analyses.* The facilities which implemented the measure were identified through systematic internet searches and through media reports. Given the information presented in the publication, it is unclear whether facilities which implemented the measure but were less successful in preventing cases did not create media attention and are therefore less likely to be included.
Bias in classification of intervention	Low	Intervention status is well-defined; and intervention definition is based solely on information collected at the time of intervention.
Bias due to deviation from intended intervention	Serious	*There were deviations from the intended interventions (in terms of implementation and/or adherence), but their impact on the direction of effect of the outcome is expected to be slight.* The focus of the analysis was implementation and adherence to self-confinement of residents and staff. In the study, self-confinement was voluntary and the study indicates that only 3/4 of the staff members volunteered to participate. Most of the infections among staff members seemed to have occurred in the staff population who did not participate in self-confinement. The analysis was not appropriate to estimate the effect of starting and adhering to intervention. This is likely to bias the strength of the effect towards the null; but is unlikely to have affected the direction of the effect as the outcome of interest. *It is unclear whether important co-interventions were balanced across intervention and control groups. The analysis was not adjusted for differences in other infection control measures (as co-interventions).* There is a risk of LTCFs with more dedication or resources to protect residents implementing the measures. These LTCFs could have been more likely to have additional infection control measures in place than those LTCFs which did not engage in self - confinement.
Bias due to missing data	Low	Data were reasonably complete
Bias in measurement of outcomes	Moderate	*The methods of outcome assessment were comparable across intervention groups and the outcome measure is only minimally influenced by knowledge of the intervention received by study participants; and any error in measuring the outcome is only minimally related to intervention status.* The fact that the relevant outcome data were acquired by self-reporting (by the directors of LTCFs) as well as a potential conflict of interest might have biased the reporting. This may be an indication of reporting bias. But it is unclear if this is the case. This would bias the effects in favour of the measure. Furthermore, there were strict symptom-based screening measures in place in all LTCFs with self-confinement and there are indications of a general high awareness for potential infections among residents and staff in the intervention group. The assessment of the outcomes by the researchers was different between intervention and comparator groups (self-reporting in the intervention group and national health report in the comparator group).

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Bias in selection of the reported result	Moderate	*The study does not refer to a study protocol or a priori defined analysis. However, the outcome measurements and analyses are clearly defined and both internally and externally consistent, there is no indication of selection of the reported analysis from among multiple analyses and there is no indication of selection of the cohort or subgroups for analysis and reporting on the basis of the results.*
Study ID	**Green 2021**	
Intervention categories	2. Contact reduction measures	
Outcomes	3. Outbreaks	
Effect	Implementation and adherence to the measure	
Overall rating	**Serious**	At least one known important confounding domain was not appropriately measured and/or not controlled for. There is a risk of bias due to differences in additional infection-control measures beyond the measure of interest, which were not adequately accounted for in the analysis. Major aspects of the assignment of intervention status were determined in a way that could have been affected by the outcome. Furthermore, it cannot be ruled out that there could have been selection effects, where LTCFs which were “more successful” in protecting the residents were selected into the study, which could have been more likely to have had implemented the intervention. These biases could favour the intervention group.
What is the overall predicted direction of bias for this outcome?	Likely favouring the control	The effect may be biased towards the intervention and towards the control. Bias due to not sufficiently assessed and adjusted for confounders and co-interventions may bias the effects in favour of the measure. However, there is a high risk of bias due to the classification of the intervention, which may bias the results towards the control.
Bias due to confounding	Serious	*At least one known important confounding domain was not appropriately measured, or not controlled for.* An imbalance between intervention and control group in different risk and protective factors inside and outside the LTCF as well as the population characteristics of the LTCF could explain the association between intervention and outcome. As the study does not adequately control for these, there is a serious risk that bias due to confounding could (at least in part) explain the observed effects.
Bias in selection of participants into the study	Moderate	*Selection into the study may have been related to intervention and outcome (but likely not strong enough to affect the direction of effect across all facilities) and this was not adjusted for in analyses.* The criterion for selecting LTCFs into the study was a history of no SARS-CoV-2 outbreak in the past, which could imply that these LTCFs were potentially more successful in protecting residents than others that implemented the measure alongside other measures. While this is unclear, it is possible that selection into the study was related to intervention and outcome and this could not be adjusted for in analyses.
Bias in classification of intervention	Serious	*Major aspects of the assignment of intervention status were determined in a way that could have been affected by the outcome.*

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		As to the status of having and not having implemented the intervention retrospectively, there is a risk of bias in misclassification. The outcomes of interest (e.g. having an outbreak or having a high number of infections) could lead affected facilities to implementing the measure as a result of the events of interest and therefore after the outcome of interest had occurred. This would bias the effect towards the control. *Intervention status not well defined* implementation and extent of the measure might have differed across LTCFs due to the binary assessment of the measure.
Bias due to deviation from intended intervention	Moderate	*Important co-interventions were not balanced across intervention groups and this was not appropriately measured, or not controlled for.* An imbalance between intervention and control group in different infection control measures (co-interventions) implemented in the LTCF could explain the association between intervention and outcome. As the study does not adequately control for these, there is a risk that bias due to confounding could (at least in part) explain the observed effects.
Bias due to missing data	Low	*Data were reasonably complete.*
Bias in measurement of outcomes	Low	*The methods of outcome assessment were comparable across intervention groups and the outcome measure was unlikely to be influenced by knowledge of the intervention received by study participants (i.e. is objective) and any error in measuring the outcome is unrelated to intervention status.*
Bias in selection of the reported result	Moderate	*The study does not refer to a study protocol or a priori defined analysis. However, the outcome measurements and analyses are clearly defined and both internally and externally consistent, there is no indication of selection of the reported analysis from among multiple analyses and there is no indication of selection of the cohort or subgroups for analysis and reporting on the basis of the results.*
Study ID	**Lipsitz 2020**	
Intervention categories	2. Mask and PPE use 3. Separating infected and non-infected residents	
Outcomes	1. Number of infections: mean weekly infections rates 1. Number of infections: odds of having a weekly infection rate of zero infections	
Effect	Implementation and adherence to the measure	
Overall rating	**Serious**	Insufficient assessment of and adjustment for confounding factors and co-interventions. As the measures were implemented as part of a larger multicomponent infection control intervention, there is a risk that co-interventions may have moderated the effects. Insufficient adjustment of the lag time between intervention implementation and occurrence of the outcome might have biased the results.
What is the overall predicted direction of bias for this outcome?	Likely favouring the measure	The effect may be biased towards the intervention and towards the control. Bias in selection of the reported results as well as bias due to the presence of co-interventions, which were not adjusted for in the analysis, are likely to have biased the results in favour of the measure. As the lag time between intervention implementation and outcome of interest were not accounted for in the analysis, there is a risk that the results are biased towards the null.

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		It is unclear, but likely the effect of the latter is more pronounced.
Bias due to confounding	Serious	*At least one known important confounding domain was not appropriately measured, or not controlled for.* An imbalance between intervention and control group in different risk and protective factors inside and outside the LTCF as well as the population characteristics of the LTCF could explain the association between intervention and outcome. As the study does not adequately control for these, there is a serious risk that bias due to confounding could (at least in part) explain the observed effects.
Bias in selection of participants into the study	Low	*There is no indication that selection into the study may have been related to intervention and outcome and start of follow-up and start of intervention likely coincided.*
Bias in classification of intervention	Low	*Intervention status is well defined; and intervention definition is based solely on information collected at the time of intervention.*
Bias due to deviation from intended intervention	Serious	*It is unclear whether important co-interventions were balanced across intervention and control groups. The analysis was not adjusted for differences in other infection control measures (as co-interventions).* It is likely that facilities varied in the infection control measures in place. This was not adequately accounted and adjusted for in the analysis. As the intervention status changed over time and more LTCFs implemented the measure at different time-points, it is not unlikely that co-interventions differed across the follow-up. *There were no deviations from the intended interventions (in terms of implementation or adherence) that were likely to impact on the outcome.*
Bias due to missing data	Low	*Data were reasonably complete.*
Bias in measurement of outcomes	Moderate	*The methods of outcome assessment were comparable across intervention groups and the outcome measure. It is possible, that the outcome assessment was influenced by intervention status in a way that would affect the direction of effect.* The study used data from monthly and bi-weekly LTCF audits as well as aggregated census data on the outcomes of interest. The study reports that mass mandatory testing of residents and staff was part of the larger underlying multicomponent intervention. This could bias the results, if not balanced between the intervention and control group. The study provides insufficient information here. *It is unclear whether an error in measuring the outcome was related to intervention status.* In the analysis, the association between the weekly rate of infections and the implementation of the measure was assessed at the same time point. Due to the delay between implementation of the measure and effects on infections, there is a risk that the effect is biased towards the null. However, it is unclear how strong this effect likely is.
Bias in selection of the reported result	Serious	*There is a high risk of selective reporting from among multiple analyses* The authors only included “statistically significant” measures into their model (mask wearing if infections are present in the LTCF and cohorting of infected residents). The other core competencies were not reported; likely because

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		they were "not significant" (closing of public spaces, screening for signs and symptoms of COVID-19, existence of transmission control policies, and training for mask wearing).
Study ID:	**Lipsitz 2020**	
Intervention categories	2. Mask and PPE use 3. Separating infected and non-infected residents	
Outcomes	5. Number of deaths: mean weekly mortality rates 5. Number of deaths: odds of having a weekly mortality rate of zero deaths	
Effect	Implementation and adherence to the measure	
Overall rating	**Serious**	Insufficient assessment of and adjustment for confounding factors and co-interventions. As the measures were implemented as part of a larger multicomponent infection control intervention, there is a risk that co-interventions may have moderated the effects. Insufficient adjustment of the lag time between intervention implementation and occurrence of the outcome may bias the results.
What is the overall predicted direction of bias for this outcome?	Likely direction of bias towards the null	The effect may be biased towards the intervention and towards the control. However, bias in selection of the reported results as well as bias due to the presence of co-interventions, which were not adjusted for in the analysis, are likely to bias the results in favour of the measure. As the lag time between intervention implementation and outcome of interest were not accounted for in the analysis, there is a risk that the results are biased towards the null. Likely, this effect is not strong enough to counteract the effect of biases due to confounding and the presence of co-interventions.
Bias due to confounding	Serious	*At least one known important confounding domain was not appropriately measured, or not controlled for.* An imbalance between intervention and control group in different risk and protective factors inside and outside the LTCF as well as the population characteristics of the LTCF could explain the association between intervention and outcome. As the study does not adequately control for these, there is a serious risk that bias due to confounding could (at least in part) explain the observed effects.
Bias in selection of participants into the study	Low	*There is no indication that selection into the study may have been related to intervention and outcome and start of follow-up and start of intervention likely coincided.*
Bias in classification of intervention	Low	*Intervention status is well defined; and intervention definition is based solely on information collected at the time of intervention.*
Bias due to deviation from intended intervention	Serious	*It is unclear whether important co-interventions were balanced across intervention and control groups. The analysis was not adjusted for differences in other infection control measures (as co-interventions).* It is likely that facilities varied in the infection control measures in place. This was not adequately accounted and adjusted for in the analysis. As the intervention status changed over time and more LTCFs implemented the measure at different time-points, it is not unlikely that co-interventions differed across the follow-up.

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		There were no deviations from the intended interventions (in terms of implementation or adherence) that were likely to impact on the outcome.
Bias due to missing data	Low	*Data were reasonably complete.*
Bias in measurement of outcomes	Serious	*The methods of outcome assessment were comparable across intervention groups and the outcome measure. It is possible that the outcome assessment was influenced by intervention status in a way that would affect the direction of effect.* The study reports that mass mandatory testing of residents and staff was part of the larger underlying multicomponent intervention. This could bias the results, if not balanced between the intervention and control group. The study provides insufficient information here. *Error in measuring the outcome was related to intervention status.* In the analysis, the association between the weekly rates of death and the implementation of the measure was assessed at the same time point. Due to the delay between implementation of the measure and effects on mortality; there is a risk that the effect is biased towards the null.
Bias in selection of the reported result	Serious	*There is a high risk of selective reporting from among multiple analyses* The authors only included "statistically significant" measures into their model (mask wearing if infections are present in the LTCF and cohorting of infected residents). The other core competencies were not reported; likely because they were "not significant" (closing of public spaces, screening for signs and symptoms of COVID-19, existence of transmission control policies, and training for mask wearing).
Study ID	**Lipsitz 2020**	
Intervention categories	5. Multicomponent outbreak control measures	
Outcomes	1. Number of infections: mean weekly infections rates 1. Number of infections: odds of having a weekly infection rate of zero infections	
Effect	Implementation and adherence to the measure	
Overall rating	**Serious**	Insufficient assessment of and adjustment for confounding factors. Insufficient adjustment of the lag time between intervention implementation and occurrence of the outcome may bias the results.
What is the overall predicted direction of bias for this outcome?	Unpredictable	The effect may be biased towards the intervention and towards the control. It is unclear in which direction insufficient adjustment for confounders would bias the effect. As the lag time between intervention implementation and outcome of interest were not accounted for in the analysis, there is a risk that the results are biased towards the null. The strength of this effect is unclear
Bias due to confounding	Serious	*At least one known important confounding domain was not appropriately measured, or not controlled for.* An imbalance between intervention and control group in different risk and protective factors inside and outside the LTCF as well as the population characteristics of the LTCF could explain the association between intervention and

(Continued)

		outcome. As the study does not adequately control for these, there is a serious risk that bias due to confounding could (at least in part) explain the observed effects.
Bias in selection of participants into the study	Low	*There is no indication that selection into the study may have been related to intervention and outcome and start of follow-up and start of intervention likely coincided.*
Bias in classification of intervention	Low	*Intervention status is well defined; and intervention definition is based solely on information collected at the time of intervention.*
Bias due to deviation from intended intervention	Moderate	*It is unclear whether important co-interventions were balanced across intervention groups.* Due to the multi-component nature of the measure, many different co-interventions were included in the measure itself. While the study did not assess and account for additional co-interventions, their impact on the outcome is expected to be slight. *It is unclear, whether there were deviations from the intended interventions (in terms of implementation or adherence) that were likely to impact the outcome.*
Bias due to missing data	Low	*Data were reasonably complete.*
Bias in measurement of outcomes	Moderate	*The methods of outcome assessment were comparable across intervention groups and the outcome measure. It is possible that the outcome assessment was influenced by intervention status in a way that would affect the direction of effect.* The study reports that mass mandatory testing of residents and staff was part of the larger underlying multicomponent intervention. This could bias the results, if not balanced between the intervention and control group. The study provides insufficient information here. *It is unclear whether an error in measuring the outcome was related to intervention status.* In the analysis, the association between the weekly rate of infections and the implementation of the measure was assessed at the same time point. Due to the delay between implementation of the measure and effects on infections; there is a risk that the effect is biased towards the null. However, it is unclear how strong this effect likely is.
Bias in selection of the reported result	Moderate	*The study does not refer to a study protocol or a priori defined analysis. However, the outcome measurements and analyses are clearly defined and both internally and externally consistent, there is no indication of selection of the reported analysis from among multiple analyses and there is no indication of selection of the cohort or subgroups for analysis and reporting on the basis of the results.*
Study ID	**Lipsitz 2020**	
Intervention categories	5. Multicomponent outbreak control measures	
Outcomes	5. Number of deaths: mean weekly mortality rates 5. Number of deaths: odds of having a weekly mortality rate of zero deaths	
Effect	Implementation and adherence to the measure	

(Continued)

Overall rating	**Serious**	Insufficient assessment of and adjustment for confounding factors. Insufficient adjustment of the lag time between intervention implementation and occurrence of the outcome may bias the results.
What is the overall predicted direction of bias for this outcome?	Likely direction of bias towards the null	The effect may be biased towards the intervention and towards the control. It is unclear in which direction insufficient adjustment for co-founders would bias the effect. As the lag time between intervention implementation and outcome of interest were not accounted for in the analysis, there is a risk that the results are biased towards the null. The strength of this effect is unclear
Bias due to confounding	Serious	*At least one known important confounding domain was not appropriately measured, or not controlled for.* An imbalance between intervention and control group in different risk and protective factors inside and outside the LTCF as well as the population characteristics of the LTCF could explain the association between intervention and outcome. As the study does not adequately control for these, there is a serious risk that bias due to confounding could (at least in part) explain the observed effects.
Bias in selection of participants into the study	Low	*There is no indication that selection into the study may have been related to intervention and outcome and start of follow-up and start of intervention likely coincided.*
Bias in classification of intervention	Low	*Intervention status is well defined; and intervention definition is based solely on information collected at the time of intervention.*
Bias due to deviation from intended intervention	Moderate	*It is unclear whether important co-interventions were balanced across intervention groups.* Due to the multi-component nature of the measure, many different co-interventions were included in the measure itself. While the study did not assess and account for additional co-interventions, their impact on the outcome is expected to be slight. *It is unclear, whether there were deviations from the intended interventions (in terms of implementation or adherence) that were likely to impact the outcome.*
Bias due to missing data	Low	*Data were reasonably complete.*
Bias in measurement of outcomes	Serious	*The methods of outcome assessment were comparable across intervention groups and the outcome measure. It is possible that the outcome assessment was influenced by intervention status in a way that would affect the direction of effect.* The study reports that mass mandatory testing of residents and staff was part of the larger underlying multicomponent intervention. This could bias the results, if not balanced between the intervention and control group. The study provides insufficient information here. *Error in measuring the outcome was related to intervention status.* In the analysis, the association between the weekly rate of death and the implementation of the measure was assessed at the same time point. Due to the delay between implementation of the measure and effects on mortality, there is a risk that the effect is biased towards the null.

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Bias in selection of the reported result	Moderate	*The study does not refer to a study protocol or a priori defined analysis. However, the outcome measurements and analyses are clearly defined and both internally and externally consistent, there is no indication of selection of the reported analysis from among multiple analyses and there is no indication of selection of the cohort or subgroups for analysis and reporting on the basis of the results.*
Study ID	**Lombardo 2021**	
Intervention categories	4. Isolation of cases	
Outcomes	3. Outbreaks	
Effect	Implementation and adherence to the measure	
Overall rating	**Serious**	Inadequate assessment of and adjustment for confounding factors and the presence of co-interventions associated with intervention and control, such as risk and protective factors of interest. The intervention is not well defined, and there is a serious risk of bias due to misclassification of the measure. No information is reported about missing data or the potential for data to be missing.
What is the overall predicted direction of bias for this outcome?	Unpredictable	The effect may be biased towards the intervention and towards the control; it is unclear which effect is likely to be more pronounced
Bias due to confounding	Serious	*At least one known important confounding domain was not appropriately measured, or not controlled for.* The authors did not sufficiently control for the effect of several relevant potential confounders, such as characteristics of the LTCF, of the population residing in the LTCF, and of the community in which the LTCF is placed.
Bias in selection of participants into the study	Moderate	*Selection into the study may have been related to intervention and outcome and this was not adjusted for in analyses, although this is not clear.* Given the relatively low response rate of < 50%, a selection bias cannot be ruled out. There may be facilities which participated in the study were "more successful" in protecting residents which overall could be associated with having implemented the measure of interest, alongside with other measures.
Bias in classification of intervention	Serious	*Major aspects of the assignments of intervention status were determined in a way that could have been affected by the outcome.* As the status of having and not having "problems in isolation" is defined retrospectively, there is a risk of bias in misclassification. The outcomes of interest (e.g. having an outbreak or having a high number of infections) could lead affected facilities to implement the measure as a reaction to the outcome (e.g. an outbreak leading to problems in isolation, rather than vice versa). Furthermore, a deviation in terms of LTCFs reporting "problems in isolating individuals" still being able to do so adequately, and the LTCFs reporting not being able to do so using appropriate approaches cannot be ruled out. This would bias the effect towards the control. *The intervention status is not well defined* The authors assessed the association with COVID-19 free status with the response to "problems in quarantine/isolating" infected or exposed individuals, rather than the more clearly defined approach to isolate individuals (e.g. not being able to isolate individuals, isolation in single rooms was possible etc.).

(Continued)

		Therefore, it is unclear what "problems in isolation" entails and how the relation to the measure of interest is.
Bias due to deviation from intended intervention	Serious	*It is unclear whether important co-interventions were balanced across intervention and control groups. The analysis was not adjusted for differences in other infection control measures (as co-interventions).* It is likely that facilities varied in the infection control measures in place in the facility. This was not adequately accounted and adjusted for in the analysis.
Bias due to missing data	No information	*No information is reported about missing data or the potential for data to be missing.*
Bias in measurement of outcomes	Moderate	*The methods of outcome assessment were comparable across intervention groups and the outcome measure is only minimally influenced by the intervention received by study participants; and any error in measuring the outcome is likely not related strongly enough to the intervention status to affect the direction of effect.* As the definition of "COVID-19 free status" depends on a positive RT-PCR-based test for SARS-CoV-2 and there may have been gaps in testing, even in residents with flu-like symptoms, it cannot be ruled out that a relevant number of LTCFs were misclassified as COVID-19-free due to lack of testing. It is unclear whether LTCFs with higher probability for (more) testing of residents and staff are associated with receiving the intervention or not, but this cannot be ruled out.
Bias in selection of the reported result	Moderate	*The study does not refer to a study protocol or a priori defined analysis. However, the outcome measurements and analyses are clearly defined and both internally and externally consistent, there is no indication of selection of the reported analysis from among multiple analyses and there is no indication of selection of the cohort or subgroups for analysis and reporting on the basis of the results.*
Study ID	**McArthur 2021**	
Intervention categories	1. Admission restrictions for visitors (in combination of measures to reduce the adverse effects of the visiting restrictions)	
Outcomes	6. Adverse and other unintended mental or physical health outcomes	
Effect	Implementation and adherence to the measure	
Overall rating	**Serious**	Inadequate assessment of and adjustment for confounding factors and the presence of co-interventions associated with intervention and control, such as risk and protective factors of interest. There are some indications of selection of the reported results, but this is unclear.
What is the overall predicted direction of bias for this outcome?	Unpredictable	The effect may be biased towards the intervention and towards the control; it is unclear which effect is likely to be more pronounced
Bias due to confounding	Serious	*At least one known important confounding domain was not appropriately measured, or not controlled for.* An imbalance between intervention and control group in different risk and protective factors inside and outside the LTCF as well as the population characteristics of the LTCF could explain the association between intervention and outcome. As the study does not adequately control for these, there is a serious

(Continued)

		risk that bias due to confounding could (at least in part) explain the observed effects.
Bias in selection of participants into the study	Low	*There is no indication that selection into the study may have been related to intervention and outcome and start of follow-up and start of intervention likely coincided.*
Bias in classification of intervention	Low	*Intervention status is well defined; and intervention definition is based solely on information collected at the time of intervention.*
Bias due to deviation from intended intervention	Serious	*It is unclear whether important co-interventions were balanced across intervention and control groups. The analysis was not adjusted for differences in other infection control measures (as co-interventions).* It is likely that facilities varied in the infection control measures in place. The analysis was adjusted for the type of facility in the analysis; but not for specific co-interventions implemented in them. *It is unclear whether there were deviations from the intended interventions (in terms of implementation or adherence) that were likely to impact on the outcome.*
Bias due to missing data	Low	*Data were reasonably complete.*
Bias in measurement of outcomes	Moderate	The methods of outcome assessment were likely comparable across intervention groups, the outcome measure is only minimally influenced by knowledge of the intervention received by study participants and any error in measuring the outcome is likely only minimally related to intervention status.
Bias in selection of the reported result	Serious	*The study does not refer to a study protocol or a priori defined analysis. While this is unclear, there are some indications of selection of the reported analysis from among multiple analyses or of selecting subgroups for analysis and reporting in a way that might affect the results.*
Study ID	**Reyné 2020**	
Intervention categories	2. Mask and PPE use	
Outcomes	1. Number of infections among residents	
Effect	Implementation and adherence to the measure	
Overall rating	**Serious**	Inadequate assessment of and adjustment for confounding factors and the presence of co-interventions associated with intervention and control, such as risk and protective factors of interest. There are some indications of selection of the reported results, but this is unclear. Insufficient information in some domains of bias prevents a clear assessment of the risk of bias in the study.
What is the overall predicted direction of bias for this outcome?	Unpredictable	The effect may be biased towards the intervention and towards the control; it is unclear which effect is likely to be more pronounced
Bias due to confounding	Serious	*At least one known important confounding domain was not appropriately measured, or not controlled for.* An imbalance between intervention and control group in different risk and protective factors inside and outside the LTCF as well as the population char-

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		acteristics of the LTCF could explain the association between intervention and outcome. As the study does not adequately control for these, there is a serious risk that bias due to confounding could (at least in part) explain the observed effects.
Bias in selection of participants into the study	Moderate	*It is unclear whether the selection into the study may have been related to intervention and outcome. This was not adjusted for in analyses.* It is unclear how the facilities included in the analysis were selected.
Bias in classification of intervention	Low	*Intervention status is well defined; and intervention definition is likely based on information collected at the time of intervention.*
Bias due to deviation from intended intervention	Serious	*It is unclear whether important co-interventions were balanced across intervention and control groups. The analysis was not adjusted for differences in other infection control measures (as co-interventions).* It is likely that facilities varied in the infection control measures in place in the facility. While the analysis assesses and accounts for some relevant co-interventions, likely not all relevant infection-control measures in place in the facilities were accounted for.
Bias due to missing data	Low	*Data were reasonably complete*
Bias in measurement of outcomes	Moderate	*It is unclear whether the methods of outcome assessment were comparable across intervention groups.* Due to lack of information, it is unclear what types of testing regimes were used in the facilities, which could affect the rate of infections being detected and therefore counted as cases.
Bias in selection of the reported result	Moderate	*The study does not refer to a study protocol or a priori defined analysis. However, the outcome measurements and analyses are clearly defined and both internally and externally consistent, there is no indication of selection of the reported analysis from among multiple analyses and there is no indication of selection of the cohort or subgroups for analysis and reporting on the basis of the results.*
Study ID	**Shallcross 2021**	
Intervention categories	1. Admission restrictions for new residents 1. Admission restrictions for visitors	
Outcomes	1. Infections among residents 1. Infections among staff members 1. Large outbreaks (≥ 20 cases) 2. Contamination	
Effect	Implementation and adherence to the measure	
Overall rating	**Serious**	Insufficient assessment of and adjustment for all relevant confounding factors and co-interventions.
What is the overall predicted	Unpredictable	The effect may be biased towards the intervention and towards the control. It is unclear, which effect is likely to be more pronounced

(Continued)

direction of bias for this outcome?		
Bias due to confounding	Serious	*At least one known important confounding domain was not appropriately measured, or not controlled for.* An imbalance between intervention and control group in different risk and protective factors inside and outside the LTCF as well as the population characteristics of the LTCF could explain the association between intervention and outcome. While the study adjusts the assessment for a number of confounders, not all relevant confounders are adjusted sufficiently. There is a risk that these confounding factors could (at least in part) explain the observed effects.
Bias in selection of participants into the study	Low	*There is no indication that selection into the study may have been related to intervention and outcome and start of follow-up and start of intervention likely coincided.*
Bias in classification of intervention	Moderate	*Intervention status is well defined. Some aspects of the assignments of intervention status were determined retrospectively.*
Bias due to deviation from intended intervention	Serious	*It is unclear whether important co-interventions were balanced across intervention and control groups. The analysis may not have been sufficiently adjusted for differences in other infection control measures (as co-interventions).* It is likely that facilities varied in the infection control measures in place in the facility. While the analysis accounts for a number of infection control measures in place, it does not take into account the timing of the implementation of these measures. *It is unclear whether there were deviations from the intended interventions (in terms of implementation and/or adherence), but their impact on the direction of effect of the outcome is expected to be slight.*
Bias due to missing data	Low	*Data were reasonably complete*
Bias in measurement of outcomes	Moderate	*It is unclear whether the methods of outcome assessment were comparable across intervention groups.* Due to lack of information, it is unclear what types of testing regimes were used in the facilities and if those were associated with the status of intervention and control groups. If LTCFs which had implemented more measures were more likely to conduct testing of residents and staff, this could affect the rate of infections being detected and therefore counted as cases.
Bias in selection of the reported result	Moderate	*The study does not refer to a study protocol or a priori defined analysis. However, the outcome measurements and analyses are clearly defined and both internally and externally consistent, there is no indication of selection of the reported analysis from among multiple analyses and there is no indication of selection of the cohort or subgroups for analysis and reporting on the basis of the results.*
Study ID	**Shallcross 2021**	
Intervention categories	2. Barrier nursing for infected residents 2. Cleaning frequency 3. Isolation of cases	

(Continued)

	3. Separating infected and non-infected residents	
Outcomes	1. Infections among residents 1. Infections among staff members 1. Large outbreaks (≥ 20 cases) 3. Outbreaks	
Effect	Implementation and adherence to the measure	
Overall rating	**Serious**	Insufficient assessment of and adjustment for all relevant confounding factors and co-interventions. Major aspects of the assignments of intervention status were determined in a way that could have been affected by the outcome; i.e. that the classification as an intervention group may have been due to the outcome of interest.
What is the overall predicted direction of bias for this outcome?	Likely favouring the control	The effect may be biased towards the intervention and towards the control. Bias due to not having sufficiently assessed and adjusted for confounders and co-interventions may bias the effects in favour of the measure. However, there is a high risk of bias due to the classification of the intervention, which may bias the results towards the control.
Bias due to confounding	Serious	*At least one known important confounding domain was not appropriately measured, or not controlled for.* An imbalance between intervention and control group in different risk and protective factors inside and outside the LTCF as well as the population characteristics of the LTCF could explain the association between intervention and outcome. While the study adjusts the assessment for a number of co-founders, not all relevant confounders are adjusted sufficiently. There is a risk that these confounding factors could (at least in part) explain the observed effects.
Bias in selection of participants into the study	Low	*There is no indication that selection into the study may have been related to intervention and outcome and start of follow-up and start of intervention likely coincided.*
Bias in classification of intervention	Serious	*Major aspects of the assignments of intervention status were determined in a way that could have been affected by the outcome.* As the status of having and not having implemented the measure is conducted retrospectively, there is a risk of bias in misclassification. The outcomes of interest (e.g. having an outbreak or having a high number of infections) could lead affected facilities to implement the measure as a reaction to outcomes (e.g. facilities being more likely to increase the frequency of cleaning after detecting an outbreak). The study did not adequately account for this effect. This would bias the effect towards the control.
Bias due to deviation from intended intervention	Serious	*It is unclear whether important co-interventions were balanced across intervention and control groups. The analysis may not have sufficiently adjusted for differences in other infection control measures (as co-interventions).* It is likely that facilities varied in the infection control measures in place in the facility. While the analysis accounts for a number of infection control measures in place, it does not take into account the timing of the implementation of these measures.

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		It is unclear whether there were deviations from the intended interventions (in terms of implementation and/or adherence), but their impact on the direction of effect of the outcome is expected to be slight.
Bias due to missing data	Low	*Data were reasonably complete*
Bias in measurement of outcomes	Moderate	*It is unclear whether the methods of outcome assessment were comparable across intervention groups.* Due to lack of information, it is unclear what types of testing regimes were used in the facilities and if those were associated with the status of intervention and control groups. If LTCFs which had implemented more measures were more likely to conduct testing of residents and staff, this could affect the rate of infections being detected and therefore counted as cases.
Bias in selection of the reported result	Moderate	*The study does not refer to a study protocol or a priori defined analysis. However, the outcome measurements and analyses are clearly defined and both internally and externally consistent, there is no indication of selection of the reported analysis from among multiple analyses and there is no indication of selection of the cohort or subgroups for analysis and reporting on the basis of the results.*
Study ID	**Telford 2020**	
Intervention categories	3. Routine testing of residents and staff independent of symptom status	
Outcomes	1. Infections among residents 1. Infections among staff	
Effect	Implementation and adherence to the measure	
Overall rating	**Serious**	Insufficient assessment of and adjustment for all relevant confounding factors and co-interventions. Major aspects of the assignments of intervention status were determined in a way that could have been affected by the outcome; i.e. that the classification as an intervention group may have been due to the outcome of interest. It is unclear whether the selection into the study may have been related to intervention and outcome.
Likely direction of bias	Unpredictable	The effect may be biased towards the intervention and towards the control. It is unclear which of these effects is likely to be more prominent
Bias due to confounding	Serious	*At least one known important confounding domain was not appropriately measured, or not controlled for.* An imbalance between intervention and control group in different risk and protective factors inside and outside the LTCF as well as the population characteristics of the LTCF could explain the association between intervention and outcome. While the study adjusts the assessment for a number of co-founders, not all relevant confounders are adjusted sufficiently. There is a risk that these confounding factors could (at least in part) explain the observed effects.
Bias in selection of participants into the study	Moderate	*It is unclear whether the selection into the study may have been related to intervention and outcome. This was not adjusted for in analyses.*
Bias in classification of intervention	Low	*Intervention status is well defined; and intervention definition is based solely on information collected at the time of intervention.*

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Bias due to deviation from intended intervention	Serious	*It is unclear whether important co-interventions were balanced across intervention and control groups. The analysis did not adjust sufficiently for differences in infection control measures (as co-interventions).* It is possible that facilities varied in the infection control measures in place in the facilities. While the analysis accounts for a number of infection control measures in place, it does not take into account the timing of the implementation of these measures. *It is unclear whether there were deviations from the intended interventions (in terms of implementation and/or adherence), but their impact on the direction of effect of the outcome is expected to be slight.*
Bias due to missing data	Low	*Data were reasonably complete*
Bias in measurement of outcomes	Moderate	*It is unclear whether the methods of outcome assessment were comparable across intervention groups.* Due to lack of information, it is unclear what types of testing regimes were used in the facilities and if those were associated with the status of intervention and control groups. If LTCFs which had implemented more measures were more likely to conduct testing of residents and staff, this could affect the rate of infections being detected and therefore counted as cases.
Bias in selection of the reported result	Moderate	*The study does not refer to a study protocol or a priori defined analysis. However, the outcome measurements and analyses are clearly defined and both internally and externally consistent, there is no indication of selection of the reported analysis from among multiple analyses and there is no indication of selection of the cohort or subgroups for analysis and reporting on the basis of the results.*
Study ID	**Telford 2020**	
Intervention categories	3. Routine testing of residents and staff independent of symptom status	
Outcomes	4. Hospitalisations among residents 4. Hospitalisations among staff 5. Deaths among residents 5. Deaths among staff	
Effect	Implementation and adherence to the measure	
Overall rating	**Serious**	Insufficient assessment of and adjustment for all relevant confounding factors and co-interventions. Major aspects of the assignments of intervention status were determined in a way that could have been affected by the outcome; i.e. that the classification as an intervention group may have been due to the outcome of interest. It is unclear whether the selection into the study may have been related to intervention and outcome.
Likely direction of bias	Unpredictable	The effect may be biased towards the intervention and towards the control. It is unclear which of these effects is likely to be more prominent
Bias due to confounding	Serious	*At least one known important confounding domain was not appropriately measured, or not controlled for.* An imbalance between intervention and control group in different risk and protective factors inside and outside the LTCF as well as the population char-

(Continued)

		acteristics of the LTCF could explain the association between intervention and outcome. While the study adjusts the assessment for a number of confounders, not all relevant confounders are adjusted sufficiently. There is a risk that these confounding factors could (at least in part) explain the observed effects.
Bias in selection of participants into the study	Moderate	*It is unclear whether the selection into the study may have been related to intervention and outcome. This was not adjusted for in analyses.*
Bias in classification of intervention	Low	*Intervention status is well defined; and intervention definition is based solely on information collected at the time of intervention.*
Bias due to deviation from intended intervention	Serious	*It is unclear whether important co-interventions were balanced across intervention and control groups. The analysis did not adjust sufficiently for differences in infection control measures (as co-interventions).* It is possible that facilities varied in the infection control measures in place in the facilities. While the analysis accounts for a number of infection control measures in place, it does not take into account the timing of the implementation of these measures. *It is unclear whether there were deviations from the intended interventions (in terms of implementation and/or adherence), but their impact on the direction of effect of the outcome is expected to be slight.*
Bias due to missing data	Low	*Data were reasonably complete*
Bias in measurement of outcomes	Low	*The methods of outcome assessment were likely comparable across intervention groups, the outcome measure is likely only minimally influenced by knowledge of the intervention received by study participants; and any error in measuring the outcome is likely only minimally related to intervention status.*
Bias in selection of the reported result	Moderate	*The study does not refer to a study protocol or a priori defined analysis. However, the outcome measurements and analyses are clearly defined and both internally and externally consistent, there is no indication of selection of the reported analysis from among multiple analyses and there is no indication of selection of the cohort or subgroups for analysis and reporting on the basis of the results.*
Study ID	**Vijh 2021**	
Intervention categories	1. Multicomponent outbreak control measures	
Outcomes	1. Infections among residents 1. Infections among staff	
Effect	Assignment to the intervention	
Overall rating	**Moderate**	Confounding is likely; all known important confounding domains are appropriately measured and controlled for (by design or the analytical approach). No serious residual confounding is expected. The study does not provide a study protocol, therefore a risk of post-hoc selection of the time point of interruption cannot be ruled out. While there are some concerns regarding the validity and reliability of the strength of the effect estimate, it is unlikely that the bias of this study was sufficient to change the direction of the effect estimate.
Predicted direction of bias	Unpredictable	The direction to which bias could affect the results is unclear.

(Continued)

Bias due to confounding	Moderate	*Confounding is likely; all known important confounding domains are appropriately measured and controlled for (by design or the analytical approach). No serious residual confounding is expected.*
Bias in selection of participants into the study	Low	*Likely, all participants who would have been eligible for the target trial were included in the study* *Start of follow up and start of intervention coincided;* in terms of relation of intervention start and time to interruption and overall observation period.
Bias in classification of intervention	Moderate	*Intervention status is well defined. It is unclear whether some aspects of the assignments of intervention status were determined retrospectively.* As no protocol was provided, it cannot be ruled out that the time point of the interruption — and thereby the distinction between pre-intervention time points and post-intervention time points — could have been influenced by the outcome data. However, there is no clear indication that a post-hoc definition of the time point of the interruption took place or that more suitable time points could have been chosen.
Bias due to deviation from intended intervention	Moderate	*Any deviations from intended intervention reflected usual practice* The effects of any preparatory (pre-interruption) phases of the intervention were appropriately accounted for, referring to published research findings to justify the results. There is a risk of bias that the intervention could have had effects prior to the specified interruption time point. This would bias the effect towards the null.
Bias due to missing data	Low	*Data were reasonably complete.*
Bias in measurement of outcomes	Low	*The methods of outcome assessment were comparable before and after the intervention, and it is unlikely that knowledge of the intervention received by study participants or the outcome assessors had an effect favouring intervention or comparison.* *There is no indication of systematic errors in measurement of the outcome coincident with implementation of the intervention.*
Bias in selection of the reported result	Moderate	*The study does not refer to a study protocol or a priori defined analysis. However, the outcome measurements and analyses are clearly defined and both internally and externally consistent, there is no indication of selection of the reported analysis from among multiple analyses and there is no indication of selection of the cohort or subgroups for analysis and reporting on the basis of the results.*

LTCFs: long-term care facilities; **PPE:** personal protective equipment

Appendix 8. Risk of bias of observational studies not assessed with ROBINS-I

Study ID	**Rolland 2020**
Intervention categories	2. Mask and PPE use 2. Contact reduction measures 2. Personal hygiene measures and practices

(Continued)

	2. Multicomponent contact-regulating and transmission-reducing measures 2. Cohorting residents and staff
Outcomes	3. Outbreaks
Effect	Starting and adhering to intervention
Overall risk of bias	**Serious**
Overall rating justification/comments	At least one known important confounding domain and co-interventions were not appropriately measured, or not controlled for. There is a risk of bias due to classification of interventions; with LTCFs with higher disease burdens being more likely to implement measures, rather than those which have lower case loads (bias by indication).
Were the groups comparable other than by the outcome status in cases or absence of the outcome status in controls?	Probably no
	Serious
	The study does not provide enough information to assess the comparability of the facilities classified as cases or controls. It is likely that the facilities were not comparable regarding all relevant confounding factors, including additional infection control measures implemented in the facilities.
Were cases and controls matched appropriately?	Probably no
	Serious
	The study does not provide enough information to judge the process of matching cases and controls. Likely, no characteristics other than the outcome status of interest were taken into account in the matching process.
Were the same criteria used for identification of cases and controls?	Yes
	Low
	-
Was exposure measured in a standard, valid and reliable way?	Probably no
	Serious
	Major aspects of the classification as having implemented the measure (the exposure) were determined in a way that could have been affected by outcome status. Retrospective assessment of objective measures. Due to limited assessment of timing, it cannot be ruled out that the facilities introduced the measure as a reaction to the presence of the outcome, rather than vice versa. Questions (often binary, limited options) provide limited granularity which may not adequately capture relevant differences in exposure status
Was exposure measured in the same way for cases and controls?	Yes
	Low

(Continued)

	-
Were confounding factors identified?	Yes
	Moderate
	The study systematically assesses some, but not all relevant confounders. Several confounders were identified and considered, but there was no systematic assessment of confounders (e.g. logic models, DAGs) and based on the logic model of this review, it likely was not comprehensive
Were strategies to deal with confounding factors stated?	Yes
	Low
	Study does report on strategies to deal with confounding factors
Were outcomes assessed in a standard, valid and reliable way for cases and controls?	Probably no
	Serious
	There is a risk of controls (LTCF without cases) having undetected infections among staff or residents, which did not lead to major outbreaks. It can be assumed, that major outbreaks would have been detected. There is risk of bias caused by more systematic testing in some LTCFs, if a stricter testing regime was also associated with having implemented the measures of interest.
Was the exposure period of interest long enough to be meaningful?	Yes
	Low
	-
Was appropriate statistical analysis used?	Probably yes
	Moderate
	The statistical analysis of a logistic regression is appropriate; insufficient variables were included in the analysis. Stronger study designs would provide more reliable results.
Study ID	**Telford 2021**
Intervention categories	1. Quarantine for new admissions 2. M ask and PPE use 2. Cleaning and environmental hygiene measures 2. Cleaning frequency 2. Contact reduction measures 3. Symptom-based surveillance 4. Separating infected and non-infected residents
Outcomes	1. Infections: size of outbreak
Effect	Starting and adhering to intervention

(Continued)

Overall risk of bias	**Serious**
Overall rating justification/comments	At least one known important confounding domain and co-interventions were not appropriately measured, or not controlled for. There is a risk of bias due to classification of interventions, with LTCFs with higher disease burden being more likely to implement measures, rather than those which have lower case loads (bias by indication).
Were the groups comparable other than by the outcome status in cases or absence of the outcome status in controls?	Probably no
	Serious
	The study does not provide enough information to assess the comparability of the facilities classified as cases or controls. It is likely that the facilities were not comparable regarding all relevant confounding factors, including additional infection control measures implemented in the facilities.
Were cases and controls matched appropriately?	Probably no
	Serious
	The study does not provide enough information to judge the process of matching cases and controls. Likely, no characteristics other than the outcome status of interest were taken into account in the matching process.
Were the same criteria used for identification of cases and controls?	Yes
	Low
	-
Was exposure measured in a standard, valid and reliable way?	Probably no
	Serious
	Major aspects of the classification as having implemented the measure (the exposure) were determined in a way that could have been affected by outcome status. Retrospective assessment of objective measures. Due to limited assessment of timing, it cannot be ruled out that the facilities introduced the measure as a reaction to the presence of the outcome, rather than vice versa. Questions (often binary, limited options) provide limited granularity which may not adequately capture relevant differences in exposure status
Was exposure measured in the same way for cases and controls?	Yes
	Low
	-
Were confounding factors identified?	No
	Serious
	The study does not systematically assess relevant confounders.

(Continued)

	Neither in terms of characteristics of the LTCF, of the residents and staff population, of the location the LTCF is placed in, or other co-interventions
Were strategies to deal with confounding factors stated?	No
	Serious
	Study does not report on strategies to deal with confounding factors
Were outcomes assessed in a standard, valid and reliable way for cases and controls?	Probably yes
	Moderate
	There is a possibility of cases missed due to different approaches in testing and assessment. However, there is no indication that a more intensive approach to testing was associated with the intervention of interest.
Was the exposure period of interest long enough to be meaningful?	Yes
	Low
	-
Was appropriate statistical analysis used?	No
	Serious
	Statistical analysis was insufficient to control for important confounding domains and co-interventions

LTCFs: long-term care facilities; **PPE:** personal protective equipment

Appendix 9. Quality assessment of modelling studies

Delaunay 2020		
Model structure	1. Are the structural assumptions transparently stated together with their respective justifications?	No to minor concerns
	1. Comments	Structure is transparent and justified, a simple model.
	2. Are the structural assumptions and justifications reasonable, given the overall scope of the model?	Major concerns
	2. Comments	Model assumptions seem to be too simplistic: for example, there is no difference between workers and patients at the LTCF in interaction and transmission probability. Infectiousness is assumed to be constant over the course of an infection. Presymptomatic/asymptomatic cases are not considered.
Input data	3. Are the input parameters and data transparently stated?	No to minor concerns

(Continued)

	3. Comments	Input parameters are given with reference to literature, and only few input parameters are needed.
	4. Are the input parameters and data suitable to reliably populate the model?	No to minor concerns
	4. Comments	Input parameters are reasonable, and the LCTF structure does not require many parameters.
Validation (external)	5. Have indications of external validity been reported?	Major concerns
	5. Comments	No external validation
	6. Has the model been externally validated to a reasonable extent?	Major concerns
	6. Comments	No external validation: Figure 2 implies that more tests are needed if the testing strategy is 100% every 14 days compared to 100% every 7 days. This is questionable and likely due to the design of the study, tests/day would be a more reasonable measure.
Validation (internal)	7. Have indications of internal validity been reported?	Major concerns
	7. Comments	No internal validation
	8. Has the model been internally validated to a reasonable extent?	Major concerns
	8. Comments	No internal validation
Uncertainty	9. Was there an adequate assessment of the effects of uncertainty?	Moderate concerns
	9. Comments	1000 simulations for each scenario to account for stochastic uncertainties, IQRs are given for delay to first diagnosis and cumulative cases; variation in values for the reproductive number in LTCFs, latency period, test sensitivity and community transmission are analysed in sensitivity analysis; no assessment of structural uncertainties
Transparency	10. Is replication of model results possible with the materials provided by the authors?	No to minor concerns
	10. Comments	With the given data, the replication of results seems possible, the code is available on GitHub .
Overall judgment: critical concerns		
Holmdahl 2021		
Model structure	1. Are the structural assumptions transparently stated together with their respective justifications?	No to minor concerns

(Continued)

	1. Comments	The structure is transparent, the model is complex but well described, visualisation is presented
	2. Are the structural assumptions and justifications reasonable, given the overall scope of the model?	No to minor concerns
	2. Comments	Model assumptions are justified, distinction in contact patterns and risk of infectivity between residents and staff is reasonable, cohorting of residents in COVID-19 vs non COVID-19 cohort is clearly described. Contact structure might be specific for the LTCF in Massachusetts. It is unclear how influx and outflux (death) of people is shown in the figures
Input data	3. Are the input parameters and data transparently stated?	No to minor concerns
	3. Comments	Table for input parameters is given, source for most parameters is given
	4. Are the input parameters and data suitable to reliably populate the model?	No to minor concerns
	4. Comments	Input parameters seem reasonable
Validation (external)	5. Have indications of external validity been reported?	Major concerns
	5. Comments	No external validation
	6. Has the model been externally validated to a reasonable extent?	Major concerns
	6. Comments	No external validation. With daily antigen testing the cumulative incidence in the LTCF is 25% after 6 months, this seems to be unreasonably high.
Validation (internal)	7. Have indications of internal validity been reported?	Major concerns
	7. Comments	No internal validation
	8. Has the model been internally validated to a reasonable extent?	Major concerns
	8. Comments	No internal validation
Uncertainty	9. Was there an adequate assessment of the effects of uncertainty?	Moderate concerns
	9. Comments	Conducted 100 simulations to obtain cumulative incidence; sensitivity analyses for staff to resident contact rates, SARS-CoV-2 transmission in the community and efficacy of PPE; variations in the relationship between viral load and infectiousness; no variation in contact structure assessed. Uncertainties are reported suboptimally, parameter uncertainty should have been conducted more comprehensively.

(Continued)

Transparency	10. Is replication of model results possible with the materials provided by the authors?	No to minor concerns
	10. Comments	The code is available on GitHub; replication of results seems possible
Overall judgment: moderate concerns		
Knock 2021		
Model structure	1. Are the structural assumptions transparently stated together with their respective justifications?	No to minor concerns
	1. Comments	The structure is stated comprehensively in the supplement.
	2. Are the structural assumptions and justifications reasonable, given the overall scope of the model?	Moderate concerns
	2. Comments	Generally elaborate structure informed by many data sources. Difficult to plausibly assess reasonability. LTCFs are explicitly modelled, but only represented by few variables. Deterministic compartment may fail to capture the dynamics correctly. Effects across regional boundaries are neglected but mentioned in the discussion.
Input data	3. Are the input parameters and data transparently stated?	No to minor concerns
	3. Comments	Many different sources (especially CHESS and Government's Corona-Virus dashboard). Input parameters transparently stated. Some parameters have been calibrated from data, clearly stated
	4. Are the input parameters and data suitable to reliably populate the model?	Moderate concerns
	4. Comments	Input parameters seem reasonable as far as assessable, but the model needs a lot of parameters. Overall, data nicely calibrated. But calibration does specifically not fit the care home data well enough (Figure 6), suggesting that LTCFs are inappropriately described by the model.
Validation (external)	5. Have indications of external validity been reported?	Major concerns
	5. Comments	No external validation
	6. Has the model been externally validated to a reasonable extent?	Major concerns
	6. Comments	No external validation. Data do not represent care home data perfectly
Validation (internal)	7. Have indications of internal validity been reported?	Major concerns

(Continued)

	7. Comments	No internal validation reported
	8. Has the model been internally validated to a reasonable extent?	Major concerns
	8. Comments	No internal validation reported
Uncertainty	9. Was there an adequate assessment of the effects of uncertainty?	Moderate concerns
	9. Comments	Bayesian uncertainty analysis is rather comprehensive for all outputs. Credible intervals are given for COVID-19 mortality, IFR, number of deaths for different scenarios. Not exactly clear how "confidence intervals" are derived in this context. No assessment of structural uncertainties even though there are some concerns that the structural assumptions of how LTCFs enter the model are suitable.
Transparency	10. Is replication of model results possible with the materials provided by the authors?	No to minor concerns
	10. Comments	The code and data are available on GitHub. With the supplementary material the replication of results seems feasible.
Overall judgment: moderate concerns		
Love 2021		
Model structure	1. Are the structural assumptions transparently stated together with their respective justifications?	Major concerns
	1. Comments	Not all structural aspects are fully clear (dynamic network model). Use of severity scale not entirely clear. Some scenarios are not explained in detail ("gradual decrease" of adherence, but not specified, "up to 50 contacts"). There is a noticeable lack of justification of the chosen structural elements.
	2. Are the structural assumptions and justifications reasonable, given the overall scope of the model?	Moderate concerns
	2. Comments	It is unreasonable that the 2 possible vaccination effects have not been considered in stratified analyses. Contact structure seemingly reasonable but difficult to fully assess, given the available information. Overall, structure seems to be fine, but there are some concerns due to not fully transparent presentation of the methods.
Input data	3. Are the input parameters and data transparently stated?	Moderate concerns
	3. Comments	Model parameters are mostly stated, but there is a severe lack of sources. More detailed description of randomised individual infectiousness in this model is missing.

(Continued)

	4. Are the input parameters and data suitable to reliably populate the model?	Major concerns
	4. Comments	The parameters on the infectiousness and related morbidity and mortality is assumed as too high. Empirical studies on outbreaks in LTCFs with partly vaccinated residents and staff showed considerably lower rates of infections and staff than what was predicted in the model. Difficult to assess whether the rate of infection transmission is large (it would have been good to have the effective R0). Community prevalence of almost 2% seems rather high.
Validation (external)	5. Have indications of external validity been reported?	Major concerns
	5. Comments	No external validation
	6. Has the model been externally validated to a reasonable extent?	Major concerns
	6. Comments	No external validation. Additionally, even with perfect vaccination and strict adherence, 50 individuals out of 150 are infected (median). This seems questionable.
Validation (internal)	7. Have indications of internal validity been reported?	Major concerns
	7. Comments	No internal validation
	8. Has the model been internally validated to a reasonable extent?	Major concerns
	8. Comments	No internal validation
Uncertainty	9. Was there an adequate assessment of the effects of uncertainty?	Major concerns
	9. Comments	Stochastic uncertainty of different scenarios is covered, suggests non-robust outcome measure due to wide spread of values. Other uncertainties have not been assessed, which is insufficient.
Transparency	10. Is replication of model results possible with the materials provided by the authors?	Moderate concerns
	10. Comments	The code is apparently available on request or upon publication. Information in study alone might be insufficient to allow for replication of results.
Overall judgment: critical concerns		
Nguyen 2020		
Model structure	1. Are the structural assumptions transparently stated together with their respective justifications?	No to minor concerns

(Continued)

	1. Comments	Structure is explained and justified for the most part. Difficult to verify whether everything is adequately described, but it does seem so.
	2. Are the structural assumptions and justifications reasonable, given the overall scope of the model?	Moderate concerns
	2. Comments	There are some concerns regarding the chosen model structure regarding the way infection transmission is modelled. All disease states seemingly modelled with equal infectiousness (also over time), this is problematic if there is premature isolation of individuals. Many infection characteristics are modelled as constant over the course of a single simulation run, random variables might be more appropriate. The decision to seed one infection into the LTCF is questionable when interventions such as "Isolation upon admission" are investigated.
Input data	3. Are the input parameters and data transparently stated?	No to minor concerns
	3. Comments	All input parameters are clearly stated with their respective sources regarding their values and their meaning. Distributions for probabilistic sensitivity analyses have been appropriately specified.
	4. Are the input parameters and data suitable to reliably populate the model?	No to minor concerns
	4. Comments	Input parameters seem reasonable. Generally difficult to assess the induced reproduction number, as only more mechanistic parameters are given.
Validation (external)	5. Have indications of external validity been reported?	Moderate concerns
	5. Comments	There have been references to observation studies for some minor aspects which do not validate the main model outcomes. Additionally, the study authors conferred with care home stakeholders (more generally people experienced with the intended scope of application) in the model-building process
	6. Has the model been externally validated to a reasonable extent?	Major concerns
	6. Comments	Despite small indications of validity, a more quantitative/formal external validation is needed to improve the rating. Additionally, almost all runs lead to peak of infections at the start and considerable number of cumulative infections under any strategy, which seems a bit questionable. Efficacy of entry testing measures difficult to interpret with seeded infection.
Validation (internal)	7. Have indications of internal validity been reported?	Major concerns
	7. Comments	No internal validation

(Continued)

	8. Has the model been internally validated to a reasonable extent?	Major concerns
	8. Comments	No internal validation
Uncertainty	9. Was there an adequate assessment of the effects of uncertainty?	Moderate concerns
	9. Comments	Seemingly, many aspects were analysed in uncertainty analysis, but the impact of the uncertainties on the results are not analysed rigorously: • in the main document, uncertainties are generally stochastic uncertainties with base case parameters. Impact of parameter uncertainties are described qualitatively, although the relative effects between strategies need quantitative parameter uncertainty propagation • the probabilistic sensitivity analysis was used to calculate partial rank correlation coefficients, but only a few of these parameters were used for more extensive uncertainty analyses (although many had significant impact) • overall, the actual underlying uncertainty on the results is practically not assessable given the analysis in the study
Transparency	10. Is replication of model results possible with the materials provided by the authors?	Major concerns
	10. Comments	The code has not been made available and replication of results might be challenging given the detailed and complex agent-based approach
Overall judgment: moderate concerns		
See 2020		
Model structure	1. Are the structural assumptions transparently stated together with their respective justifications?	Moderate concerns
	1. Comments	The structure is partly explained in the supplement. Visualisation might have been helpful.
	2. Are the structural assumptions and justifications reasonable, given the overall scope of the model?	Major concerns
	2. Comments	Reed-Frost model is likely too simplistic to describe outbreaks correctly (no contact structure, dynamics only based on R0, discrete generations). Stochasticity in important variables, such as generation time and symptomatic time is not accounted for. Quantifying the effect of different interventions as reductions in R0 may be too simplistic. Transparency: “P” is wrongly defined and the implemented binomial chain dynamics are not explained in detail.
Input data	3. Are the input parameters and data transparently stated?	No to minor concerns

(Continued)

	3. Comments	Table for input parameters with sources is given. Most of the input parameters are reasonable.
	4. Are the input parameters and data suitable to reliably populate the model ?	No to minor concerns
	4. Comments	Calibration of R0 is only vaguely described in text, but important. The estimate for R0 is likely crude and unmitigated value of 1.4 seems unreasonably low. Reduction of 10% of effectiveness in case isolation is not justified.
Validation (external)	5. Have indications of external validity been reported?	Major concerns
	5. Comments	No external validation
	6. Has the model been externally validated to a reasonable extent?	Major concerns
	6. Comments	No external validation. Figure 1: It is questionable that the percentage of cases prevented stays exactly the same when likelihood of SARS-CoV-2 introduction is varied
Validation (internal)	7. Have indications of internal validity been reported?	Major concerns
	7. Comments	No internal validation
	8. Has the model been internally validated to a reasonable extent?	Major concerns
	8. Comments	No internal validation
Uncertainty	9. Was there an adequate assessment of the effects of uncertainty?	Major concerns
	9. Comments	Sensitivity analysis: 4 different infectivity profiles are used, likelihood for different levels of virus introduction is evaluated. Since R0 is strongly dependent on the LTCF, variation in R0 is missing but mentioned in the discussion. Structural uncertainty is not assessed even though it would be important. Reed-Frost-model should be stochastic, but no assessment of stochastic uncertainty is conducted.
Transparency	10. Is replication of model results possible with the materials provided by the authors?	No to minor concerns
	10. Comments	The code is available on GitHub. With the information in study and supplement, replication of results is quite possible.
Overall judgment: critical concerns		
Smith 2020a		

(Continued)

Model structure	1. Are the structural assumptions transparently stated together with their respective justifications?	No to minor concerns
	1. Comments	Explanation of the model structure and analyses is well structured and elaborated. Reference for the contact network model is presented, but a more detailed description is necessary to understand important features of the assumed population.
	2. Are the structural assumptions and justifications reasonable, given the overall scope of the model?	Moderate concerns
	2. Comments	Model structure attains a high level of face validity through realistic contact network and transmission model. Assumption of constant infectiousness throughout the infectious period is inappropriate. Assuming PCR sensitivity to follow a fixed time course independent of the random disease course is problematic, as infectiousness will likely correlate with PCR sensitivity. Detailed mechanistic model makes it difficult to assess which conclusions are generalisable, as outcomes cannot be uniquely linked to the model properties.
Input data	3. Are the input parameters and data transparently stated?	No to minor concerns
	3. Comments	Input parameters are stated with some references and marked as “assumed” if no reference is available. The contact network and its modification is stated through a reference.
	4. Are the input parameters and data suitable to reliably populate the model?	No to minor concerns
	4. Comments	There are no significant concerns with the input parameters.
Validation (external)	5. Have indications of external validity been reported?	Moderate concerns
	5. Comments	Model predictions are compared qualitatively to some other study results.
	6. Has the model been externally validated to a reasonable extent?	Major concerns
	6. Comments	The provided external validation is only qualitative and only validates outcomes to a negligible extent. The output for the distribution of secondary cases does not match the high over-dispersion found for COVID-19.
Validation (internal)	7. Have indications of internal validity been reported?	Moderate concerns
	7. Comments	The model is built on an established implementation in C++ (CTC-Modeler). The empirical model output for generated secondary infections by index case was compared against the nominal value of R0.

(Continued)

	8. Has the model been internally validated to a reasonable extent?	Moderate concerns
	8. Comments	Although the model is built on established implementation, the specialisation necessary for the study has not been validated by the modellers.
Uncertainty	9. Was there an adequate assessment of the effects of uncertainty?	Moderate concerns
	9. Comments	Stochastic uncertainty has been explored by an appropriate amount of simulation runs based on the same initial conditions and quantiles for the main outcomes that have been specified. Several sensitivity analyses were conducted in some main elements, such as overall transmissibility, structure of the LTCF, sensitivity of PCR testing. However, the impact of these uncertainties is not presented in an easily extractable form and due to the complexity of the model, existence of other important uncertainties is conceivable.
Transparency	10. Is replication of model results possible with the materials provided by the authors?	Moderate concerns
	10. Comments	The code and data is only available upon "reasonable request", but is likely needed to replicate analysis due to model complexity.
Overall judgment: moderate concerns		
Smith 2020b		
Model structure	1. Are the structural assumptions transparently stated together with their respective justifications?	Major concerns
	1. Comments	The main model is referenced, but not described in the study. Not clear how the number or properties of returning patients/staff is decided/modelled
	2. Are the structural assumptions and justifications reasonable, given the overall scope of the model?	Moderate concerns
	2. Comments	Although not described, the main model is suitable. The pattern of returning individuals is unclear, but important for interpretation of results.
Input data	3. Are the input parameters and data transparently stated?	Moderate concerns
	3. Comments	Entirety of model parameters from the main model? No new parameters described/needed?
	4. Are the input parameters and data suitable to reliably populate the model?	Moderate concerns

(Continued)

	4. Comments	Outcome crucially depends on PCR sensitivity, which was questionable in the main paper.
Validation (external)	5. Have indications of external validity been reported?	Major concerns
	5. Comments	No external validation
	6. Has the model been externally validated to a reasonable extent?	Major concerns
	6. Comments	No external validation
Validation (internal)	7. Have indications of internal validity been reported?	Major concerns
	7. Comments	No internal validation
	8. Has the model been internally validated to a reasonable extent?	Major concerns
	8. Comments	No internal validation
Uncertainty	9. Was there an adequate assessment of the effects of uncertainty?	Major concerns
	9. Comments	Stochastic uncertainty is assessed (large), no other uncertainties are assessed. Sensitivity to PCR sensitivity assumption would have been a necessary analysis in this context.
Transparency	10. Is replication of model results possible with the materials provided by the authors?	Moderate concerns
	10. Comments	The code and data is only available upon "reasonable request ", the model is not replicable without the code.
Overall judgment: major concerns		
Tsoungui 2021		
Model structure	1. Are the structural assumptions transparently stated together with their respective justifications?	No to minor concerns
	1. Comments	Model structure described in detail and mainly based on CovidSim 1.1. Labelling of the supplemental figures is unclear/confusing
	2. Are the structural assumptions and justifications reasonable, given the overall scope of the model?	Major concerns
	2. Comments	Residents and staff are treated as one big population in the country; individual facilities are not distinguished.
Input data	3. Are the input parameters and data transparently stated?	Moderate concerns

(Continued)

	3. Comments	Parameters are stated, but mostly without source/justification.
	4. Are the input parameters and data suitable to reliably populate the model?	Major concerns
	4. Comments	The model has many parameters. Many of them seem to be chosen without sufficient justification.
Validation (external)	5. Have indications of external validity been reported?	Major concerns
	5. Comments	No external validation
	6. Has the model been externally validated to a reasonable extent?	Major concerns
	6. Comments	No external validation. Some model outcomes seem questionable, which might be caused by unrealistic parameters.
Validation (internal)	7. Have indications of internal validity been reported?	Moderate concerns
	7. Comments	Model is extension based on freely available CovidSim
	8. Has the model been internally validated to a reasonable extent?	Major concerns
	8. Comments	No further internal validation
Uncertainty	9. Was there an adequate assessment of the effects of uncertainty?	Major concerns
	9. Comments	No uncertainty analyses were performed.
Transparency	10. Is replication of model results possible with the materials provided by the authors?	Moderate concerns
	10. Comments	Comprehensive mathematical descriptions are provided in the supplemental information. In addition, at medRxiv a link to GitHub is provided for accessing the code. However, the link does not work.
Overall judgment: critical concerns		
Vilches 2020		
Model structure	1. Are the structural assumptions transparently stated together with their respective justifications?	No to minor concerns
	1. Comments	The structure is transparently and well described.
	2. Are the structural assumptions and justifications reasonable, given the overall scope of the model?	No to minor concerns

(Continued)

	2. Comments	The model seems very realistic. It was informed at several points by data from LTCFs in Ontario, Canada.
Input data	3. Are the input parameters and data transparently stated?	No to minor concerns
	3. Comments	All input parameters are clearly stated with their respective sources regarding their values and their meaning.
	4. Are the input parameters and data suitable to reliably populate the model?	No to minor concerns
	4. Comments	Model parameters are either taken from real LTCFs or from recent literature. The model was partly fitted to data.
Validation (external)	5. Have indications of external validity been reported?	Moderate concerns
	5. Comments	Many model characteristics were taken from data about LTCFs in Ontario. However, no explicit validation procedure was done.
	6. Has the model been externally validated to a reasonable extent?	Major concerns
	6. Comments	No quantitative external validation
Validation (internal)	7. Have indications of internal validity been reported?	Major concerns
	7. Comments	No internal validation
	8. Has the model been internally validated to a reasonable extent?	Major concerns
	8. Comments	No internal validation. Custom implementation in JULIA
Uncertainty	9. Was there an adequate assessment of the effects of uncertainty?	Moderate concerns
	9. Comments	Credible intervals for most results were calculated. However, it is unclear how this was done
Transparency	10. Is replication of model results possible with the materials provided by the authors?	No to minor concerns
	10. Comments	The code is available on GitHub, some (but not all) model details are provided in the supplement.
Overall judgment: moderate concerns		
Wilmink 2020		
Model structure	1. Are the structural assumptions transparently stated together with their respective justifications?	Moderate concerns

(Continued)

	1. Comments	Some structural assumptions are only fragmentarily stated, such as the sensitivity and frequency of PCR testing, initialisation of the model, stochastic components of the model. Crude assumptions about contacts. Attributes for staff and residents, i.e. age, comorbidities, role, etc. not considered.
	2. Are the structural assumptions and justifications reasonable, given the overall scope of the model?.	Major concerns
	2. Comments	It seems highly questionable to apply a deterministic, population-based SEIR-type model for 120 agents in an LTCF. Moreover, only one initialisation with 10 cases was considered.
Input data	3. Are the input parameters and data transparently stated?	No to minor concerns
	3. Comments	Model parameter are stated transparently including the references
	4. Are the input parameters and data suitable to reliably populate the model ?	Moderate concerns
	4. Comments	The quality of the input parameters is unclear. They were partly taken from studies that were performed in China and/or at the beginning of the pandemic, when knowledge was fragmentary.
Validation (external)	5. Have indications of external validity been reported?	Major concerns
	5. Comments	No external validation
	6. Has the model been externally validated to a reasonable extent?	Major concerns
	6. Comments	No external validation
Validation (internal)	7. Have indications of internal validity been reported?	Major concerns
	7. Comments	No internal validation
	8. Has the model been internally validated to a reasonable extent?	Major concerns
	8. Comments	No internal validation
Uncertainty	9. Was there an adequate assessment of the effects of uncertainty?	Major concerns
	9. Comments	No uncertainty analyses for most parameters were performed. Sensitivity analyses for 2 critical parameters were done.
Transparency	10. Is replication of model results possible with the materials provided by the authors?	Major concerns

(Continued)

	10. Comments	The information in the manuscript is not sufficient to replicate the results. There is no supplement with additional information, the code is not available.

Overall judgment: critical concerns

CHESS: COVID-19 Hospitalisation in England Surveillance System;**IFR:** infection fatality rate; **IQR:** interquartile range; **LTCFs:** long-term care facilities; **PPE:** personal protective equipment; **PCR:** polymerase chain reaction; **R0:** reproduction rate

Appendix 10. Entry regulation measures: study-by-study results summaries

Intervention category: short description	Comparison: short description and context	Outcome category: description and overview of direction
Belmin 2020		
Self-confinement of staff with residents Implementation and adherence to voluntary self-confinement of staff members in the LTCF in order to prevent introduction of SARS-CoV-2 infections from the community through staff into the LTCF. Facilities in the intervention group conducted different forms of testing of staff prior to entering the self-confinement. Different shares of the staff members did not participate in the measure. **Context** General infection-control measures in place and control group (not adjusted for in analysis). Visiting restrictions in the intervention group	**Measure vs no measure** Comparison of LTCFs with known implementation of self-confinement of staff with data from a national survey of 9513 LTCFs in France, which were assumed not to have implemented the measure at this point in time.	**1. Number of infections** **Number of SARS-CoV-2 infections among residents over 1 month** ***Direction of effect favours the measure (▲)*** In total, 5 cases of COVID-19 (confirmed and possible) were registered among the 1250 residents (0.4%) in the 17 LTCFs within the intervention group, and 62,368 infections among the 695,060 residents (9.0%) in the 9513 LTCFs in the national survey which served as control (OR 0.03, 95% CI 0.02 to 0.10) All cases occurred in a facility with a known case prior to the implementation of the measure, indicating the introduction of the SARS-CoV-2 infection had taken place prior to the implementation of the measure. **1. Number of infections** **Number of SARS-CoV-2 infections among staff over 1 month** ***Direction of effect favours the measure (▲)*** In total, 12 cases of COVID-19 (confirmed and possible) were registered among the 794 members of staff (1.6%) in the 17 LTCFs within the intervention group, and 29,451 infections among the 385,290 members of staff (7.6%) in the 9513 LTCFs in the national survey which served as control (OR 0.19, 95% CI 0.10 to 0.33). The cases among staff were registered among staff who did not participate in the voluntary self-confinement and/or in a facility which had reported one case prior to the implementation of the measure. **2. Probability of contamination** **Number of LTCFs with at least 1 SARS-CoV-2 infection over 1 month** ***Direction of effect favours the measure* (▲)** In total, 1 LTCF among the 17 LTCFs (5.9%) within the intervention group, and 4599 among the 9513 LTCFs (48.3%) in the national survey which served as control (OR 0.07, 95% CI 0.01 to 0.50). The 1 LTCF in the intervention group had a known case prior to the implementation of the measure, indicating the introduction of the SARS-CoV-2 infection had taken place prior to the implementation of the measure. **5. Number of deaths** **Number of deaths from COVID-19 among residents over 1 month** ***Direction of effect favours the measure* (▲)** In total, 5 COVID-19-related deaths were registered among the 1250 residents (0.4%) in the 17 LTCFs of the intervention group, and 12,516 deaths among the

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		695,060 residents (1.8%) in the national survey which served as control (OR 0.22, 95% CI 0.09 to 0.53). All COVID-19-related deaths occurred in a facility with a known case prior to the implementation of the measure, indicating the introduction of the SARS-CoV-2 infection had taken place prior to the implementation of the measure.
Knock 2021		
Visiting restrictions Reducing the contact rate between the general population and care home residents by 50% **Context** Infection-control measures in place are not described in detail, but as the baseline scenario is based on real-world data from LTCFs in England, it can be assumed that baseline infection control measures are in place in the facilities.	**Measure vs no measure** Comparison of the outcome in a baseline scenario of the model created based on real-world morbidity and mortality data with a counterfactual scenario, in which the contact rate between the general population and care home residents is reduced by 50% (the measure).	**5. Number of deaths** **Overall number of care home deaths over 6 months** ***Direction of effect favours the measure (▲)*** Implementing visiting restrictions showed a reduction in care home deaths in the scenario with the measure of 44%; (95% CrI 17% to 64%) in comparison with the baseline scenario without visiting restrictions after a follow-up of 6 months.
McArthur 2021		
Admission restrictions for visitors Implementation and adherence of visiting restrictions. Visitors were restricted from entering the LTCF to prevent introduction of SARS-CoV-2 infections from the community through visitors into the LTCF. **Context** A broad range of measures were implemented to keep residents and family in contact (e.g. window visits, video chats) LTCFs also halted all group activities and implemented strategies and implemented baseline infection control measures.	**Measure vs no measure** Repeated measurements of 765 residents from 7 LTCFs during a period prior to the implementation of the measure in comparison with the measurements taken of the same residents during the measure.	**6. Adverse and other unintended mental or physical health outcomes** **Number and proportion of residents experiencing depression** ***Direction of effect favours the measure* (▲)** A multivariate model showed reduced odds for experiencing depression among residents in the intervention group (aOR 0.86, 95% CI 0.66 to 1.11) **6. Adverse and other unintended mental or physical health outcomes** **Number and proportion of residents without dementia experiencing delirium** ***Direction of effect favours the comparator* (▼)** A multivariate model showed increased odds for experiencing delirium among residents in the intervention group (aOR 1.21, 95% CI 0.57 to 2.57) **6. Adverse and other unintended mental or physical health outcomes** **Number and proportion of residents with Alzheimer's and other dementias experiencing delirium** ***Direction of effect favours the measure* (▲)** A multivariate model showed reduced odds for experiencing delirium among residents with Alzheimer's in the intervention group (aOR 0.29, 95% CI 0.07 to 1.16) **6. Adverse and other unintended mental or physical health outcomes** **Number and proportion of residents experiencing behavioural problems** ***Direction of effect favours the measure* (▲)** A multivariate model showed reduced odds for experiencing behavioural problems among residents in the intervention group (aOR 0.88, 95% CI 0.72 to 1.06)

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Nguyen 2020

Quarantine for new admissions Implementation and adherence of quarantine of new admissions. All newly admitted residents undergo a 14-day quarantine (with reduced transmission probability and contact rate in the case of infection) independent of the 2 tests newly admitted residents undergo as part of the baseline control measure. **Context** Baseline control measures in place are the isolation of symptomatic cases and testing of new admissions (2 tests), social distancing and restricted visiting.	**Measure vs no measure** Comparison of outcome across 100 iterations of a scenario with the measure and a scenario without the measure (but with the basic infection control measures in place).	**1. Number of infections** **Cumulative number of infections among residents over 90 days** ***Direction of effect favours quarantine for new admissions (▲)*** 14-day quarantine for new admissions showed lower mean and median cumulative number of infections among residents across 100 iterations of the scenario with the measure (mean: 50/80 residents, median: 50/80; IQR: 47-53) in comparison with the scenario without the measure (but testing of newly admissions twice) (mean: 53/80 residents, median: 53/80; IQR: 49-57) after a follow-up of 90 days. The 95% CI of the difference 1.9 to 3.8, P value: <0.01 (Welch's t-test; 2 tailed; including Bonferroni correction)

Shallcross 2021

Admission restrictions for new residents Implementation and adherence of admission restrictions for new residents. **Context** LTCFs have implemented different infection control measures in the facility. Those were not sufficiently accounted for in the analysis.	**Measure vs no measure** A multivariate logistic regression model of 5126 LTCFs describes the change in outcomes related to each 1 unit increase in admissions. The baseline (no new admissions) was used as a proxy for the measure. Analysis did adjust for other infection-control measures implemented in the facility and several confounding factors.	**1. Number of infections** **Probability of infections among residents** ***Direction of effect favours the measure (▲)*** In total, the LTCFs reported 19,571 confirmed cases of a SARS-CoV-2 infection among residents, equivalent to a weighted period prevalence of 10.5% (95% CI 9.9 to 11.1). The logistic regression model presented in the publication used the data of a subset including 3311 LTCFs. The model shows an increase in the odds of infections among residents for each new resident admitted to an LTCF (aOR 1.01, 95% CI 1.01 to 1.01)
		1. Number of infections **Probability of infections among staff** ***Null effect (◀▶)*** In total, the LTCFs reported 10,630 confirmed cases of a SARS-CoV-2 infection among members of staff, equivalent to a weighted period prevalence of 3.8% (95% CI 3.4 to 4.2). The logistic regression model presented in the publication used the data of a subset including 3138 LTCFs. The model shows no change in odds of infections among members of staff for each new resident admitted to an LTCF (aOR 1.00, 95% CI 1.00 to 1.01).
		1. Number of infections **Probability of large outbreaks** **Null effect (◀▶)** In total, 469 of 5126 LTCFs (9.1%) reported a large outbreak (≥ 20 cases). The logistic regression model presented in the publication used the data of a subset including 1811 LTCFs with 310 reporting a large outbreak. The model

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		shows no change of odds of a large outbreak within a LTCF for each new resident admitted (aOR 1.00, 95% CI 0.99 to 1.02).
		2. Probability of contamination **Probability of contamination** ***Direction of effect favours the measure* (▲)** In total, 2724 of 5126 LTCFs (53.1%) reported an outbreak or — based on our process model — contamination (≥ 1 cases). The logistic regression model presented in the publication used the data of a subset including 3129 LTCFs. The model shows an increase in the odds of a LTCF being contaminated with at least 1 confirmed case of SARS-CoV-2 for each additional week of delay (aOR 1.08, 95% CI 1.05 to 1.10).
Admission restrictions for visitors Implementation and adherence to admission restrictions for visitors. A multivariate logistic regression model describes the change in outcomes for each additional week of no visitor restrictions. The baseline (the earliest implementation in the dataset) was seen as the early implementation of visitor restrictions.	**Sooner implementation vs later implementation** A multivariate logistic regression model of 5126 LTCFs describes the change in outcomes related to each week of delay in implementing the measure. The baseline was used as a proxy for the measure. Analysis did adjust for other infection control measures implemented in the facility and several confounding factors.	**1. Number of infections** **Number and proportion of infections among residents** ***Direction of effect favours the measure* (▲)** In total, the LTCFs reported 19,571 confirmed cases of a SARS-CoV-2 infection among residents, equivalent to a weighted period prevalence of 10.5% (95% CI 9.9 to 11.1). The logistic regression model presented in the publication used the data of a subset including 3311 LTCFs. The model shows an increase in the odds of infections among residents for each additional week of delay (aOR 1.02, 95% CI 1.00 to 1.04).
		1. Number of infections **Number and proportion of infections among staff** ***Direction of effect favours the measure* (▲)** In total, the LTCFs reported 10,630 confirmed cases of a SARS-CoV-2 infection among members of staff, equivalent to a weighted period prevalence of 3.8% (95% CI 3.4 to 4.2). The logistic regression model presented in the publication used the data of a subset including 3138 LTCFs. The model shows an increase in the odds of infections among members of staff for each additional week of delay (aOR 1.02, 95% CI 1.00 to 1.03).
		1. Number of infections **Probability of large outbreaks** ***Direction of effect favours the measure* (▲)** In total, 469 of 5126 LTCFs (9.1%) reported a large outbreak (≥ 20 cases). The logistic regression model presented in the publication used the data of a subset including 1881 LTCFs with 310 reporting a large outbreak. The model shows an increase of the odds of infections among residents for each additional week of delay (aOR 1.06, 95% CI 0.96 to 1.17).
		2. Probability of contamination **Probability of contamination** ***Direction of effect favours the comparator* (▼)** In total, 2724 of 5126 LTCFs (53.1%) reported an outbreak or — based on our process model — contamination (≥ 1 cases). The logistic regression model presented in the publication used the data of a subset including 3129 LTCFs. The model shows a decrease in the odds of a LTCF being contaminated with at least 1 confirmed case of SARS-CoV-2 for each additional week of delay (aOR 0.99, 95% CI 0.92 to 1.07).
Smith 2020a		
Testing of new admissions Implementation and adherence to testing	**Measure vs no measure**	**1. Number of infections** **Number of infections upon detection of the outbreak** ***Direction of effect favours the measure (▲)***

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new admissions with a pooled PCR test (assumed lower sensitivity than regular PCR test). **Context** Modelled facility with 170 residents and 240 staff. Model assumes limited baseline control measures in place. Residents and staff with severe COVID-19-like symptoms are tested with a PCR test.	Comparison of the median outcome across 100 iterations of a scenario with the measure and a scenario with symptom-based testing only	The median number of infections among residents upon detection of an outbreak (i.e. a resident or staff receiving a positive test result) across the 100 iterations of the model, was higher in the scenario without the measure (median: 26 cases/410 residents and staff, central range of the simulation results at the 95% level, 1 to 116), in comparison with the scenario with the measure (median: 12/410, 95% interval: 1 to 79)
Testing of new admissions Implementation and adherence to testing new admissions with a pooled PCR test (assumed lower sensitivity than regular PCR test). **Context** Modelled facility with 30 geriatric residents and 44 staff. Model assumes limited baseline control measures in place. Residents and staff with severe COVID-19-like symptoms are tested with a PCR test.		**1. Number of infections** **Number of infections upon detection of outbreak** ***Direction of effect favours the measure (▲)*** The median number of infections among residents upon detection of an outbreak (i.e. a resident or staff receiving a positive test result) across the 100 iterations of the model was higher in the scenario without the measure (median: 19 cases, 95% interval: 1 to 44 cases) in comparison with the scenario with the measure (median: 4 cases, 95% interval: 1 to 28 cases).
Smith 2020b		
Intensified testing of re-admissions of residents and staff after holidays Implementation and adherence of generalised PCR-based testing (test sensitivity: 80%; turnaround time 24 h) of 100% residents and/or staff independent of symptoms following holidays, as events with high risk of infection among residents and staff. **Context**	**Measure vs no measure** Comparison of the outcome across 10,000 stochastic simulations for the scenarios of testing residents and staff in its most conservative form (testing once, sensitivity: 80%, turnaround time: 24 h) in comparison with symptom-based testing only.	**1. Number of infections** **Proportion of non-imported cases averted by testing at 2 weeks from holiday** ***Direction of effect favours testing (▲)*** Conducting generalised testing of residents and staff post-holiday in the form of the most conservative scenarios of testing (testing once), showed a higher median rate of cases averted by testing across the 10,000 iterations of the model in comparison with symptom-based testing only (median: 0%; IQR: 0%-17%). Generalised PCR-based testing once on day 1 led to a median reduction in cases of 40% (IQR: 0%-100%), testing once on day 4 led to a median reduction in cases of 16% (IQR: 0%-70%), and testing once on day 7 led to a median reduction in cases of 10% (IQR: 0%-50%).
	Higher vs lower rates of testing Comparison of the outcome across 10,000 sto-	**1. Number of infections** **Proportion of non-imported cases averted by testing at 2 weeks from holiday** ***Direction of effect favours higher rates testing***

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Model assumes baseline immunising seroprevalence among 20% of patients and staff, reinforced infection-control practices (e.g. face masks) in the form of reduced per-contact transmission risk by 80%, PCR-based testing of residents and staff with COVID-19-like symptoms and isolation of identified cases.	chastic simulations for the scenarios of testing residents and staff in the highest rate (testing 3 times post-holiday), in comparison with lower rates of testing (testing twice, testing once).	Conducting generalised testing of residents and staff post-holiday at the highest rate of testing (testing 3 times post-holiday) showed a higher median rate of cases averted by testing across the 10,000 iterations of the model in comparison with lower rates of testing over an observational period of 2 weeks since the holiday. Generalised PCR-based testing once on day 1 led to a median reduction in cases of 40% (IQR: 0%-100%), testing once on day 4 led to a median reduction in cases of 16% (IQR: 0%-70%), and testing once on day 7 led to a median reduction in cases of 10% (IQR: 0%-50%). Generalised PCR-based testing twice on day 1 and 4 led to a median reduction in cases of 70% (IQR: 5%-100%), and testing twice on day 1 and 7 post-holiday led to a median reduction in cases of 60% (IQR: 10%-100%). Generalised PCR-based testing 3 times on day 1, 4 and 7 led to a median reduction in cases of 83% (IQR: 33%-100%).
Testing of residents and staff vs testing of residents only Comparison of the outcomes across 10,000 iterations of the model in scenarios with testing of residents and staff in comparison with testing residents only for different rates of testing.	**1. Number of infections** **Proportion of non-imported cases averted by testing at 2 weeks from holiday** ***Direction of effect favours testing of residents and staff, rather than testing residents only*** Conducting generalised testing of residents and staff post-holiday showed a higher median rate of cases averted by testing across the 10,000 iterations of the model in comparison with testing residents only at the same rate of testing over an observational period of 2 weeks since the holiday. Generalised PCR-based testing of residents and staff once on day 1 led to a median reduction in cases of 40% (IQR: 0%-100%), testing once on day 4 led to a median reduction in cases of 16% (IQR: 0%-70%), and testing once on day 7 led to a median reduction in cases of 10% (IQR: 0%-50%). Testing residents only once on day 1 led to a median reduction in cases of 17% (IQR: 0%-67%), testing once on day 4 led to a median reduction in cases of 0% (IQR: 0%-67%), and testing once on day 7 led to a median reduction in cases of 0% (IQR: 0%-33%). Generalised PCR-based testing of residents and staff twice on day 1 and 4 led to a median reduction in cases of 70% (IQR: 5%-100%), and testing twice on day 1 and 7 post-holiday led to a median reduction in cases of 60% (IQR: 10%-100%). Testing only residents on day 1 and 4 led to a median reduction in cases of 30% (IQR: 0%-90%), and testing twice on day 1 and 7 post-holiday led to a median reduction in cases of 30% (IQR: 0%-90%). Generalised PCR-based testing of residents and staff 3 times on day 1, 4 and 7 led to a median reduction in cases of 83% (IQR: 33%-100%), while testing only residents 3 times on day 1, 4 and 7 led to a median reduction in cases of 40% (IQR: 0%-90%).
Testing of residents and staff vs testing of staff only Comparison of the proportion of averted cases through testing at 2 weeks from holidays in 10,000 iterations of the model in scenarios with testing of residents and staff in comparison with testing staff only.	**1. Number of infections** **Proportion of non-imported cases averted by testing at 2 weeks from holiday** ***Direction of effect favours testing of residents and staff, rather than testing staff only*** Conducting generalised testing of residents and staff post-holiday showed a higher median rate of cases averted by testing, across the 10,000 iterations of the model, in comparison with testing staff only, at the same rate of testing, over an observational period of 2 weeks since the holiday. Generalised PCR-based testing of residents and staff once on day 1 led to a median reduction in cases of 40% (IQR: 0%-100%), testing once on day 4 led to a

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		median reduction in cases of 16% (IQR: 0%-70%), and testing once on day 7 led to a median reduction in cases of 10% (IQR: 0%-50%). Testing staff only led to a median reduction in cases of 0% (IQR: 0%-40%), testing once on day 4 led to a median reduction in cases of 0% (IQR: 0%-30%), and testing once on day 7 led to a median reduction in cases of 10% (IQR: 0%-30%). Generalised PCR-based testing of residents and staff twice on day 1 and 4 led to a median reduction in cases of 70% (IQR: 5%-100%), and testing twice on day 1 and 7 post-holiday led to a median reduction in cases of 60% (IQR: 10%-100%). Testing only staff on day 1 and 4 led to a median reduction in cases of 5% (IQR: 0%-45%), and testing twice on day 1 and 7 post-holiday led to a median reduction in cases of 17% (IQR: 0%-50%). Generalised PCR-based testing of residents and staff 3 times on day 1, 4 and 7 led to a median reduction in cases of 83% (IQR: 33%-100%), while testing only staff 3 times on day 1, 4 and 7 led to a median reduction in cases of 17% (IQR: 0%-50%).
Telford 2021		
Quarantine for new admissions New admissions or readmissions required a 14-day quarantine/observation period to prevent introduction of SARS-CoV-2 from the community through admissions into the LTCF. **Context** LTCFs have implemented different infection control measures in the facility. Those were not sufficiently accounted for in the analysis.	**Measure vs no measure** Comparison of 13 LTCFs with a low prevalence of SARS-CoV-2 infections (≤ 39%) with those facilities with a high prevalence of 11 SARS-CoV-2 infections (> 39%) on whether they had implemented the measure. The overall prevalence of SARS-CoV-2 in all 24 LTCFs was used as the cut-off value for the grouping. Analysis did not adjust for other infection control measures implemented in the facility.	**1. Number of infections** **Size of SARS-CoV-2 outbreak in LTCFs** ***Direction of effect favours the measure*** **(▲)** In total, 10 out of 11 LTCFs with a high-prevalence outbreak of SARS-CoV-2, and 11 out of 13 LTCFs with a low prevalence of SARS-CoV-2 did implement the measure. This resulted in reduced odds of having a high-prevalence outbreak with the measure in place (OR 0.83, 95% CI 0.05 to 15.09)

aOR: adjusted odds ratio; **CI:** confidence interval; **CrI:** credibility interval; **IQR:** interquartile range; **LTCFs:** long-term care facilities; **OR:** odds ratio; **PCR:** polymerase chain reaction

Appendix 11. Contact-regulati ng and transmission-reducing measures: study-by-study results summaries

Intervention category: short description	Comparison: short description and context	Outcome category: description and overview of direction
Green 2021		
Contact-reduction measures	**Measure vs no measure**	**3. Outbreaks in LTCFs** **Probability of outbreaks** ***Direction of effect favours comparator*** **(▼)**

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Implementation and adherence of resident-focused contact-reduction measures The use of shared spaces within LTCFs was restricted. **Context** Baseline infection control measures were implemented in all facilities. All care homes were closed to visitors.	Comparison of LTCFs with implementation of restricted shared spaces and no implementation; with data of a two-time measurement from 34 LTCFs. Analysis did not adjust for other infection-control measures implemented in the facility or other potentially confounding variables.	A univariable analysis showed an increased relative risk of having at least one COVID-19 case in LTCFs where the measure was being implemented, in comparison with LTCFs without the measure (RR 2.63, 95% CI 0.37 to 18.45)

Holmdahl 2021

Immunity-based cohorting of residents Implementation and adherence of immunity-based cohorting. Residents who were infected and have recovered are prioritised to be placed as roommates in the shared rooms of residents who are still susceptible. **Context** Infected residents are placed in a COVID-19 cohort. Staff in the COVID-19 unit are assumed to properly use PPE, reducing the probability of infection. The mean probability of transmission upon contact implies that baseline transmission control measures are in place. Residents have reduced contact with residents outside their shared rooms.	**Immunity-based cohorting of residents vs no prioritised placement of residents** Comparison of the outcome across 100 iterations of the scenario with prioritised placement of immune residents as roommates for susceptible residents in comparison scenarios without a preferential placement of residents.	**1. Number of infections** **Mean cumulative incidence among residents over 3 months** ***Direction of effect favours measure (▲)*** Immunity-based cohorting of residents showed a lower mean cumulative number of infections among residents across 100 iterations of the scenario with the measure (mean: 24%; SD: 6%) in comparison with the scenario of no prioritised placement of staff (mean: 26%; SD: 6%) after 3 months of follow up. **1. Number of infections** **Mean cumulative incidence among staff over 3 months** ***Direction of effect favours measure (▲)*** Immunity-based cohorting of residents showed a lower mean cumulative number of infections among staff across 100 iterations of the scenario with the measure (mean: 48%; SD: 5%) in comparison with the scenario of no prioritised placement of staff (mean: 50%; SD: 6%) after 3 months of follow up.

Lipsitz 2020

Mask and PPE use Implementation and adherence to healthcare professionals being instructed to wear masks and PPE for the	**Measure vs no measure** Comparison of the outcome in LTCFs with implementation of a mask and PPE use order and	**1. Number of infections:** **Mean weekly infection rates** ***Direction of effect favours the measure* (▲)** Mask and PPE use showed a decrease in mean weekly infection rates (β coefficient: −0.23, 95% CI −0.45 to −0.01) within LTCFs with measure implementation compared with LTCFs without implementation.

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care of residents, according to the most recent official PPE guidance. **Context** Measure was implemented as part of a large multicomponent measure intended to increase the implementation and adherence of infection control measures in LTCFs.	those LTCFs without such an order based on weekly data from 123 LTCFs. Analysis did adjust for one other measure — cohorting of residents — and for infection rate in the community.	**1. Number of infections** **Probability of a weekly infection rate of zero** ***Direction of effect favours the measure* (▲)** Mask and PPE use showed increased odds of zero infections within LTCFs with measure implementation compared to LTCFS without measure implementation (aOR 2.16, 95% CI 1.42 to 3.30). **5. Number of deaths** **Mean weekly mortality rates** ***Direction of effect favours the measure* (▲)** Mask and PPE use showed a decrease in mean weekly mortality rates (β coefficient: −0.02, 95% CI −0.21 to 0.17) within LTCFs with measure implementation compared to LTCFs without implementation. **5. Number of deaths** **Probability of a weekly mortality rate of zero** ***Direction of effect favours the measure* (▲)** Mask and PPE use showed increased odds of zero deaths within LTCFs with measure implementation compared to LTCFS without measure implementation (aOR 3.20, 95% CI 1.87 to 5.48)
Love 2021		
Multicomponent transmission and contact reduction measures Strong adherence to transmission and contact control measures (physical distancing, mask wearing, restricted social mixing, etc.), implemented in the form of reduced rates of contacts and transmissions. **Context** It is assumed that both residents and staff were fully vaccinated with an overall vaccine effectiveness of 95% in the prevention of symptomatic disease. Symptomatic staff and residents are assumed to have a reduced transmission rate by 100% for staff and 90% for residents.	**Higher vs lower adherence to the infection control measure** Comparison of the outcomes across multiple iterations of a scenario with higher adherence to transmission and contact reduction measures in comparison with a scenario with lower adherence.	**1. Number of infections** **Overall number of infections among residents and staff over 100 days** ***Direction of effect favours more stringent implementation of the measure* (▲)** Implementing and adhering to more stringent multicomponent transmission- and contact-reducing measures showed a lower median number of infections among residents and staff across 100 iterations of the scenario with the measure (median: 54/150 infections; IQR: 21-81) in comparison with the scenario with less stringent measures (median: 105/150 infections; IQR: 73-129) after a follow-up of 100 days. (Figures extracted from plot.) **4. Number of hospitalisations** **Overall number of hospitalisations of residents and staff over 100 days** ***Direction of effect favours more stringent implementation of the measure* (▲)** Implementing and adhering to more stringent multicomponent transmission- and contact-reducing measures showed a lower median number of hospitalisations among residents and staff across 100 iterations of the scenario with the measure (median: 1/150 hospitalisations; IQR: 0-3) in comparison with the scenario with less stringent measures (median: 3/150 hospitalisations; IQR: 1-5) after a follow-up of 100 days. (Figures extracted from plot.) **5. Number of deaths** **Overall number of deaths among residents and staff over 100 days** ***Direction of effect favours more stringent implementation of the measure* (▲)** Implementing and adhering to more stringent multicomponent transmission- and contact-reducing measures showed a lower median of the number of hospitalisations among residents and staff across 100 iterations of the scenario with the measure (median: 0/150 deaths; IQR: 0-1) in comparison with the sce-

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		nario with less stringent measures (median: 1/150 deaths; IQR: 0-3) after a follow - up of 100 days. (Figures extracted from plot.)
Reyné 2020		
Mask and PPE use **Implementation and adherence to earlier vs later mask wearing after the detection of an outbreak in a facility.** The earliest implementation in the dataset was seen as the early implementation of mask wearing.	**Earlier vs later implementation** Comparison of the outcome in LTCFs which implemented generalised mask wearing earlier or later (in days). The comparison was given through the output of a generalised linear model with survey data of in total 12 LTCFs.	**1. Number of infections** **Number of SARS-CoV-2 infections among residents** ***Direction of effect favours the measure (▲)*** Implementation and adherence to the measure showed an increased proportion of infected residents for each day of delay in mandatory mask wearing within the LTCFs (β coefficient = 0.55; SE = 0.19). Therefore, an early implementation was associated with a lower proportion of infected residents.
Rolland 2020		
Mask and PPE use Implementation and adherence to systematic wearing of the masks by the healthcare professionals **Context** Facilities with and without a case had baseline infection control measures in place.	**Measure vs no measure** Comparison of 30 LTCFs with at least 1 COVID-19 case with 94 LTCFs without any COVID-19 case on whether they report to have implementation of the measure. Analysis did adjust for s ome but not all infection control measures in the facility as well as several potential confounding factors.	**3. Outbreaks in LTCFs** **Probability of outbreaks** ***Direction of effect favours the comparator* (▼)** In total, 75 out of 94 LTCFs without COVID-19 cases (79.8%), and 24 out of 30 LTCFs with at least one COVID-19 case (80%) did implement the measure. This results in increased odds of having at least one COVID -19 case with the measure in place (aOR 1.6, 95% CI 0.26-11.00).
Contact-reduction measures **Implementation and adherence to resident-focused contact-reduction measures** of **confinement of residents in their rooms.**		**3. Outbreaks in LTCFs** **Probability of outbreaks** ***Direction of effect favours the comparator* (▼)** In total, 69 out of 94 LTCFs without COVID-19 cases (74.2%), and 23 out of 30 LTCFs with at least one COVID-19 case (76.7%) did implement the measure. This results in increased odds of having at least one COVID-19 case with the measure in place (aOR 1.64, 95% CI 0.49-5.76) .
Contact-reduction measures **Implementation and adherence to resident-focused contact reduction measures.** **Organisation of meals** to reduce contact and risk of transmission among residents.		**3. Outbreaks in LTCFs** **Probability of outbreaks** ***Direction of effect favours the measure* (▲)** In total, 80 out of 94 LTCFs without COVID-19 cases (84.7 %), and 26 out of 30 LTCFs with at least one COVID-19 case (86.7%) did implement the measure. This results in reduced odds of having at least one COVID-19 case with the measure in place (aOR 0.63, 95% CI 0.34-1.15).
Contact-reduction measures **Implementation and adherence to resi-**		**3. Outbreaks in LTCFs** **Probability of outbreaks** ***Direction of effect favours the measure* (▲)**

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dent-focused contact reduction measures. Organisation of group activities in a way to reduce contact and risk of transmission among residents or cancelling such activities.		In total, 55 out of 94 LTCFs without COVID-19 cases (58.5%), and 20 out of 30 LTCFs with at least one COVID-19 case (66.7%) did implement the measure. This results in reduced odds of having at least one COVID-19 case with the measure in place (aOR 0.89, 95% CI 0.41 to 1.91).
Personal hygiene measures and practices Implementation of specific training on hygiene measures available to staff.		**3. Outbreaks in LTCFs** **Probability of outbreaks** ***Direction of effect favours the measure* (▲)** In total, 89 out of 94 LTCFs without COVID-19 cases (94.7%), and 27 out of 30 LTCFs with at least one COVID-19 case (90%) did implement the measure. This results in reduced odds of having at least one COVID-19 case with the measure in place (aOR 0.71, 95% CI 0.28 to 1.79).
Personal hygiene measures and practices Implementation and adherence to specific dressing procedures at the entrance.		**3. Outbreaks in LTCFs** **Probability of outbreaks** ***Direction of effect favours the measure* (▲)** In total, 14 out of 94 LTCFs without COVID-19 cases (14.9%), and 2 out of 30 LTCFs with at least one COVID-19 case (6,.7%) did implement the measure. This results in reduced odds of having at least one COVID-19 case with the measure in place (aOR 0.81, 95% CI 0.10 to 6.34).
Multicomponent contact-regulating and transmission-reducing measures Implementation and adherence to multiple contact transmission and regulation measures, including mask wearing, training on hygiene measures, and contact reduction measures focused on staff. The stringency of implementation was assessed through a self-assessment scale of the quality of the barrier measures.	**More vs less stringent implementation of the measure** Comparison of 30 LTCFs with at least one COVID-19 case with 94 LTCFs without any COVID-19 cases on the self-reported quality of adherence to infection-control measures. Analysis did adjust for some but not all infection control measures in the facility as well as several potential confounding factors.	**3. Outbreaks in LTCFs** **Probability of outbreaks** ***Direction of effect favours the measure* (▲)** Implementation and adherence to multiple contact transmission and regulation measures showed reduced odds of having at least one COVID-19 case in LTCFs with a higher score (aOR 0.55, 95% CI 0.33 to 0.93).
Cohorting residents and staff Implementation and adherence to measures focused on cohorting of residents Residents were compartmentalised in specific areas within the LTCF.	**Measure vs no measure** Comparison of 30 LTCFs with at least one COVID-19 case with 94 LTCFs without any COVID-19 cases on whether they reported to have implemented the measure. Analysis did adjust for some but not all infection-control measures in the facility as well as	**3. Outbreaks in LTCFs** **Probability of outbreaks** ***Direction of effect favours the measure* (▲)** In total, 65 out of 94 LTCFs without COVID-19 cases (69.1%), and 9 out of 30 LTCFs with at least one COVID-19 case (30%) did implement the measure. This results in reduced odds of having at least one COVID-19 case with the measure in place (aOR 0.17, 95% CI 0.04 to 0.67).
Cohorting residents and staff		**3. Outbreaks in LTCFs** **Probability of outbreaks**

(Continued)

Implementation and adherence to measures focused on cohorting of staff Members of staff were compartmentalised in specific areas within the LTCF.	several potential confounding factors.	***Direction of effect favours the comparator* (▼)** In total, 17 out of 94 LTCFs without COVID-19 cases (18.1 %), and 4 out of 30 LTCFs with at least one COVID-19 case (13.3%) did implement the measure. This results in an increase in the odds of having at least one COVID-19 case with the measure in place (aOR 3.01, 95% CI 0.51 to 18.51).

Shallcross 2021

Barrier nursing for infected residents Implementing and adhering to barrier nursing, as a set of stringent infection control measures used in nursing. **Context** Baseline infection control measures were implemented in LTCFs in intervention and control group to different extents.	**Measure vs no measure** A multivariate logistic regression model of 5126 LTCFs comparing the outcomes for LTCFs reporting to have implemented the measure and LTCFs not having implemented the measure. Analysis did adjust for other infection control measures implemented in the facility and several confounding factors.	**1. Number of infections** **Number and proportion of infections among residents** ***Direction of effect favours comparator* (▼)** In total, 12,211 cases of confirmed SARS-CoV-2 infections were registered among 78,595 residents (15.4%) within the intervention group, and 873 infections among 43,565 residents (2.5%) within the comparator group in the 3, 311 LTCFs included for this analysis. Barrier nursing for infected residents shows higher odds of observing SARS-CoV-2 infections among residents in LTCFs reporting to have implemented the measure (aOR 3.60, 95% CI 3.34 to 3.88)
		1. Number of infections **Number and proportion of infections among staff** ***Direction of effect favours comparator* (▼)** In total, 6530 cases of confirmed SARS-CoV-2 infections were registered among 119,123 members of staff (5.5%) within the intervention group, and 521 infections among 44,708 members of staff (1.2%) within the comparator group in the 3138 LTCFs included for this analysis. Barrier nursing for infected residents shows higher odds of observing SARS-CoV-2 infections among staff in LTCFs reporting to have implemented the measure (aOR 2.60, 95% CI 2.36 to 2.86)
		1. Number of infections **Probability of large outbreaks** ***Direction of effect favours comparator* (▼)** In total, 285 of 1625 LTCFs (17.5%) reported a large outbreak (≥ 20 cases) within the intervention group, and 25 of 256 LTCFs (9.8%) within the comparator group in the 1881 LTFs included for this analysis. Barrier nursing for infected residents shows higher odds of a large outbreak in LTCFs in the intervention group (aOR 1.29, 95% CI 0.79 to 2.09)
		3. Outbreaks in LTCFs **Probability of outbreaks** ***Direction of effect favours comparator* (▼)** In total, 1625 of 2046 LTCFs (79.4%) reported an outbreak (≥ 1 cases) within the intervention group, and 256 of 1083 LTCFs (23.6%) within the comparator group in the 3129 LTCFs used for this analysis. Barrier nursing for infected residents shows higher odds of a large outbreak in LTCFs in the intervention group (aOR 5.33, 95% CI 4.30 to 6.60)
Barrier nursing for all residents Barrier nursing describes a set of stringent infection control measures used in nursing. Therefore, we see barrier nursing for all residents (not depen-	**Measure vs no measure** A multivariate logistic regression model of 5126 LTCFs comparing the outcomes for LTCFs reporting to have implemented the measure and LTCFs not having	**1. Number of infections** **Number and proportion of infections among residents** ***Direction of effect favours comparator* (▼)** In total, 8956 cases of confirmed SARS-CoV-2 infections were registered among 63,891 residents (14%) within the intervention group, and 4039 infections among 49,269 residents (8.2%) within the comparator group in the 3311 LTCFs included for this analysis. Barrier nursing for all residents shows higher odds of observing SARS-CoV-2 infections among residents in LTCFs in the intervention group (aOR 1.42, 95% CI 1.37 to 1.48)

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dent on the infection status) as a proxy for a strict contact and transmission regulating measure. **Context** Baseline infection control measures were implemented in LTCFs in intervention and control group to different extents.	implemented the measure. Analysis did adjust for other infection control measures implemented in the facility and several confounding factors.	**1. Number of infections** **Number and proportion of infections among staff** ***Direction of effect favours comparator* (▼)** In total, 4922 cases of confirmed SARS-CoV-2 infections were registered among 94,163 members of staff (5.2%) within the intervention group, and 2129 infections among 69,668 members of staff (3.1%) within the comparator group in the 3138 LTCFs included for this analysis. Barrier nursing for all residents shows higher odds of observing SARS-CoV-2 infections among staff of LTCFs in the intervention group (aOR 1.39, 95% CI 1.31 to 1.46) **1. Number of infections** **Probability of large outbreaks** ***Direction of effect favours comparator* (▼)** In total, 221 of 1196 LTCFs (18.5%) reported a large outbreak within the intervention group (≥ 20 cases), and 89 of 685 LTCFs (13%) within the comparator group in the 1881 long-term care facilities included for this analysis. Barrier nursing for all residents shows higher odds of a large outbreak in LTCFs in the intervention group (aOR 1.44, 95% CI 1.08 to 1.91) **3. Outbreaks in LTCFs** **Probability of outbreaks** ***Direction of effect favours comparator* (▼)** In total, 1196 of 1742 LTCFs (68.7%) reported an outbreak of any size (≥ 1 cases) within the intervention group, and 685 of 1387 LTCFs (49.4%) within the comparator group in 3129 LTCFs used for this analysis. Barrier nursing for all residents shows higher odds of an outbreak of any size in LTCFs in the intervention group (aOR 1.68, 95% CI 1.38 to 2.05).
Cleaning frequency **Implementation and adhering to cleaning of communal areas** within a LTCF at least twice a day, in order to prevent the transmission of SARS-CoV-2 through contaminated surfaces. **Context** Baseline infection control measures were implemented in LTCFs in intervention and control group to different extents.	**Stringent measure vs less stringent measure** A multivariate logistic regression model of 5126 LTCFs comparing the outcomes for LTCFs reporting a higher stringency of implementation of the measure (cleaning twice per day, intervention group) and LTCFs reporting a lower stringency of implementation of the measure (cleaning once per day, control group). Analysis did adjust for other infection-control measures implemented in the facility and several confounding factors.	**1. Number of infections** **Number and proportion of infections among residents** ***Direction of effect favours more stringent implementation of the measure* (▲)** In total, 9487 cases of confirmed SARS-CoV-2 infections were registered among 83,396 residents (11.4%) within the intervention group (more stringent implementation), and 3193 infections among 26,511 residents (12%) within the control group (less stringent implementation) in the 3311 LTCFs included for this analysis. Implementation and adhering to cleaning of communal areas shows higher odds of observing SARS-CoV-2 infections among residents in LTCFs reporting lower frequency of cleaning in comparison with those reporting higher frequencies of cleaning (aOR 1.05, 95% CI 1.00 to 1.11). **1. Number of infections** **Number and proportion of infections among staff** ***Direction of effect favours more stringent implementation of the measure* (▲)** In total, 5035 cases of confirmed SARS-CoV-2 infections were registered among 119,764 members of staff (4.2%) within the intervention group, and 1802 infections among 39,301 members of staff (4.6%) within the control group in the 3311 LTCFs included for this analysis. Implementation and adhering to cleaning of communal areas shows higher odds of observing SARS-CoV-2 infections among staff in LTCFs reporting lower frequency of cleaning in comparison with those reporting higher frequencies of cleaning (aOR 1.10, 95% CI 1.03 to 1.17). **1. Number of infections** **Probability of large outbreaks** ***Direction of effect favours more stringent implementation of the measure* (▲)**

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		In total, 225 of 1384 LTCFs (16.3%) reported a large outbreak (≥ 20 cases) in the intervention group, and 78 of 441 LTCFs (17.7%) within the control group in the 1881 LTCFs included for this analysis. Implementation and adhering to cleaning of communal areas shows higher odds of a large outbreak in LTCFs with less stringent implementation of the measure (aOR 1.10, 95% CI 0.79 to 1.53).
		3. Outbreaks in LTCFs **Probability of outbreaks** ***Direction of effect favours more stringent implementation of the measure*** **(▲)** In total, 1384 of 2331 LTCFs (59.4%) reported an outbreak of any size (≥ 1 cases) within the intervention group, and 441 of 717 LTCFs (61.5%) in the control group in 3129 LTCFs used for this analysis. Implementation and adhering to cleaning of communal areas shows higher odds of a large outbreak in LTCFs with less stringent implementation of the measure (aOR 1.05, 95% CI 0.80 to 1.37).
Cleaning frequency Implementation and adhering to cleaning of communal touchpoints within a LTCF at least twice a day, to prevent the transmission of SARS-CoV-2 through contaminated surfaces **Context** Baseline infection control measures were implemented in LTCFs in intervention and control group to different extents.	**Stringent measure vs less stringent measure** A multivariate logistic regression model of 5126 LTCFs comparing the outcomes for LTCFs reporting a higher stringency of implementation of the measure (cleaning twice per day, intervention group) and LTCFs reporting a lower stringency of implementation of the measure (cleaning once per day, control group). Analysis did adjust for other infection-control measures implemented in the facility and several confounding factors.	**1. Number of infections** **Number and proportion of infections among residents** ***Direction of effect favours less stringent implementation of the measure*** **(▼)** In total, 11,472 cases of confirmed SARS-CoV-2 infections were registered among 98,778 residents (11.6%) within the intervention group, and 930 infections among 9648 residents (9.6%) within the control in the 3311 LTCFs included for this analysis. Implementation and adhering to cleaning of communal touchpoints shows lower odds of observing SARS-CoV-2 infections among residents in LTCFs reporting lower frequency of cleaning in comparison with those reporting higher frequencies of cleaning (aOR 0.85, 95% CI 0.79 to 0.92)
		1. Number of infections **Number and proportion of infections among staff** ***Direction of effect favours less stringent implementation of the measure*** **(▼)** In total, 6180 cases of confirmed SARS-CoV-2 infections were registered among 144,102 members of staff (4.3%) within the intervention group, and 539 infections among 12,907 members of staff (4.2%) within the control measure in the 3311 LTCFs included for this analysis. Implementation and adhering to cleaning of communal touchpoints shows slightly lower odds of observing SARS-CoV-2 infections among staff in LTCFs reporting lower frequency of cleaning in comparison with those reporting higher frequencies of cleaning (aOR 0.99, 95% CI 0.90 to 1.09).
		1. Number of infections **Probability of large outbreaks** ***Direction of effect favours less stringent implementation of the measure*** **(▼)** In total, 277 of 1643 LTCFs (16.9%) reported a large outbreak within the more stringent intervention group (≥ 20 cases), and 20 of 153 LTCFs (13.1%) within the less stringent control group in the 1881 LTCFs included for this analysis. Implementation and adhering to cleaning of communal touchpoints shows lower odds of a large outbreak in LTCFs with less stringent implementation of the measure (aOR 0.74, 95% CI 0.43 to 1.28).
		3. Outbreaks in LTCFs **Probability of outbreaks of any size** ***Direction of effect favours less stringent implementation of the measure*** **(▼)** In total, 1643 of 2741 LTCFs (59.9%) reported an outbreak (≥ 1 cases) within the more stringent intervention group, and 153 of 273 LTCFs (56%) within the less stringent control group in 3129 LTCFs used for this analysis. Implementation and adhering to cleaning of communal touchpoints model shows lower odds of a large outbreak in LTCFs with less stringent implementation of the measure (aOR 0.89, 95% CI 0.61 to 1.30).

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Cleaning frequency Implementation and adhering to cleaning of staff rooms within a LTCF at least twice a day, to prevent the transmission of SARS-CoV-2 through contaminated surfaces. **Context** Baseline infection control measures were implemented in LTCFs in intervention and control group to different extents.	**Stringent measure vs less stringent measure** A multivariate logistic regression model of 5126 LTCFs comparing the outcomes for LTCFs reporting a higher stringency of implementation of the measure (cleaning twice per day, intervention group) and LTCFs reporting a lower stringency of implementation of the measure (cleaning once per day, control group). Analysis did adjust for other infection-control measures implemented in the facility and several confounding factors.	**1. Number of infections** **Number and proportion of infections among residents** ***Direction of effect favours more stringent implementation of the measure* (▲)** In total, 6186 cases of confirmed SARS-CoV-2 infections were registered among 56,532 residents (10.9%) within the intervention group, and 5733 infections among 48,225 residents (11.9%) within the control group in the 3311 LTCFs included for this analysis. Implementation and adhering to cleaning of staff rooms shows higher odds of observing SARS-CoV-2 infections among residents in LTCFs reporting a less stringent implementation of the measure (aOR 1.02, 95% CI 0.98 to 1.07). **1. Number of infections** **Number and proportion of infections among staff** ***Direction of effect favours less stringent implementation of the measure* (▼)** In total, 3522 cases of confirmed SARS-CoV-2 infections were registered among 81,868 members of staff (4.3%) within the intervention group, and 3012 infections among 69,493 members of staff (4.3%) within the control group in the 3311 LTCFs included for this analysis. Implementation and adhering to cleaning of staff rooms shows lower odds of observing SARS-CoV-2 infections among staff in LTCFs reporting a less stringent implementation of the measure (aOR 0.91, 95% CI 0.86 to 0.96). **1. Number of infections** **Probability of large outbreaks** ***Direction of effect neither favours more stringent nor less stringent implementation of the measure* (◀▶)** In total, 147 of 922 LTCFs (15.9%) reported a large outbreak (≥ 20 cases) within the intervention group, and 138 of 802 LTCFs (17.2%) within the control group in the 1881 LTCFs included for this analysis. Implementation and adhering to cleaning of staff rooms shows no difference in the odds of a large outbreak between LTCFs with more stringent and less stringent implementation of the measure (aOR 1.00, 95% CI 0.75 to 1.35). **3. Outbreaks in LTCFs** **Probability of outbreaks of any size** ***Direction of effect favours less stringent implementation of the measure* (▼)** In total, 922 of 1573 LTCFs (58.6%) reported an outbreak of any size (≥ 1 cases) within the intervention group, and 802 of 1275 LTCFs (62.9%) within the control group in 3129 LTCFs used for this analysis. Implementation and adhering to cleaning of staff rooms shows lower odds of a large outbreak in LTCFs with a less stringent implementation of the measure (aOR 0.98, 95% CI 0.78 to 1.23).
Mask and PPE use Situation of mask use. Response to the question for the situation that best describes how the staff are using PPE (the question did not allow to estimate how stringent the adherence to PPE-usage was in these situations and did not allow for an option to respond to not use PPE. PPE included devices such as gloves and aprons and the ques-	**Different situations of PPE usage:** Comparison of the outcomes in LTCFs reporting the usage of PPE in a specific situation (when providing direct care to infected, or shielding, residents; when providing direct care to all residents, when having any contact with infected, or shielding, residents, when having any contact with all residents) in comparison with	**1. Number of infections** **Number and proportion of infections among residents** ***Effect in favour of the situation of PPE usage of "for any contact with infected or shielding residents"*** The proportion of infected residents in facilities responding to the questions on the situation of mask use with "all of the time" was 12.2% (9696 cases out of 79,786 residents). For "any contact with all residents" this was 9% (1132/12,556), for "any contact with infected or shielding residents" this was 6.9% (124/1803), for "delivering direct care to all residents" it was 10.4% (1765/16,985) and for "delivering direct care to infected or shielding residents" it was 13.7% (278/2030). **1. Number of infections** **Number and proportion of infections among staff** ***Effect in favour of the situation of PPE usage of "for any contact with infected or shielding residents"***

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tion did not distinguish between those). **Context** Baseline infection-control measures were implemented in LTCFs in intervention and control group to different extents.	the response of all the time.	The proportion of infected staff in facilities responding to the questions on the situation of mask use with "all of the time" was 4.6% (5286 cases out of 115,831 residents). For "any contact with all residents" this was 3.0% (544/18,129), for "any contact with infected or shielding residents" this was 2.0% (50/2481), for "delivering direct care to all residents" it was 4.3% (1064/24,526) and for "delivering direct care to infected or shielding residents" it was 3.7% (107/2864). **1. Number of infections** **Probability of large outbreaks** ***Effect in favour of the situation of PPE usage of "for any contact with infected or shielding residents"*** The proportion of facilities reporting a large outbreak (≥ 20 case s) among facilities with an outbreak of any size responding to the questions on the situation of mask use with "all of the time" was 16.7% (228 facilities with a large outbreak out of 1366 facilities with an outbreak of any size). For "any contact with all residents" this was 15.2% (29/191), for "any contact with infected or shielding residents" this was 8.0% (2/25), for "delivering direct care to all residents" it was 16.7% (45/269) and for "delivering direct care to infected or shielding residents" it was 20.0% (6/30). **3. Outbreaks in LTCFs** **Probability of outbreaks of any size** ***Effect in favour of the situation of PPE usage of "For any contact with all residents"*** The proportion of facilities reporting an outbreak of any size (≥ 1 case) among facilities responding to the questions on the situation of mask use with "all of the time" was 62.2% (1,366 facilities with outbreaks out of 2197 facilities). For "any contact with all residents" this was 50.9% (191/375), for "any contact with infected or shielding residents" this was 53.2% (25/47), for "delivering direct care to all residents" it was 58.2% (269/462) and for "delivering direct care to infected or shielding residents" it was 62.5% (30/48).
Telford 2021		
Mask use **Implementation and adherence to correct and proper use of masks by staff inside the COVID- 19 unit.** **Context** Baseline infection control measures were in place in the intervention and the control group.	**Measure vs no measure** Comparison of 13 LTCFs with a low prevalence of SARS-CoV-2 infections (≤ 39%) with those facilities with a high prevalence of 11 SARS-CoV-2 infections (> 39%) on whether they had implemented the measure. The overall prevalence of SARS-CoV-2 infections in all 24 LTCFs was used as cut-off value for the grouping. Analysis did not adjust for other infection control measures implemented in the facility.	**1. Number of infections** **Size of SARS-CoV-2 outbreak in LTCFs** ***Direction of effect favours the measure (▲)*** In total, 5 out of 11 LTCFs with a high-prevalence outbreak of SARS-CoV-2 infections (≥ 39% infection prevalence), and 13 out of 13 LTCFs with a low prevalence of SARS-CoV-2 infections (≤ 39% infection prevalence) did implement the measure. This results in reduced odds of having a high-prevalence outbreak with the measure in place (OR 0.03, 95% CI 0.00-0.66).
Mask use **Correct and proper use of masks by staff**		**1. Number of infections** **Size of SARS-CoV-2 outbreak in LTCFs** ***Direction of effect favours the measure (▲)***

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outside the COVID- 19 unit. **Context** Baseline infection control measures were in place in the intervention and the control group.	In total, 7 out of 11 LTCFs with a high-prevalence outbreak of SARS-CoV-2 infections (≥ 39% infection prevalence), and 12 out of 13 LTCFs with a low prevalence of SARS-CoV-2 infections (≤ 39% infection prevalence) did implement the measure. This results in reduced odds (17%) of having a high-prevalence outbreak with the measure in place (OR 0.15, 95% CI 0.01-1.58).
Mask use **Training and audits to ensure proper mask and PPE usage by staff.** Training and frequent audits are conducted to ensure proper mask use by staff. **Context** Baseline infection control measures were in place in the intervention and the control group.	**1. Number of infections** **Size of SARS-CoV-2 outbreak in LTCFs** ***Direction of effect favours the measure (▲)*** In total, 4 out of 11 LTCFs with a high-prevalence outbreak of SARS-CoV-2 infections (≥ 39% infection prevalence), and 11 out of 13 LTCFs with a low prevalence of SARS-CoV-2 infections (≤ 39% infection prevalence) did implement the measure. This results in reduced odds of having a high-prevalence outbreak with the measure in place (OR 0.10, 95% CI 0.01-0.73).
Mask use **Training and audits to ensure proper mask and PPE usage by staff** Staff are trained to self-fit N95 masks. **Context** Baseline infection control measures were in place in the intervention and the control group.	**1. Number of infections** **Size of SARS-CoV-2 outbreak in LTCFs** ***Direction of effect favours the measure (▲)*** In total, 4 out of 11 LTCFs with a high-prevalence outbreak of SARS-CoV-2 infections (≥ 39% infection prevalence), and 8 out of 13 LTCFs with a low prevalence of SARS-CoV-2 infections (≤ 39% infection prevalence) did implement the measure. This results in reduced odds of having a high-prevalence outbreak with the measure in place (0.36, 95% CI 0.07-1.88).
Mask use **Training and audits to ensure proper mask and PPE usage by staff** Staff are trained and audits take place to ensure proper donning and doffing of PPE. **Context**	**1. Number of infections** **Size of SARS-CoV-2 outbreak in LTCFs** ***Direction of effect favours the measure (▲)*** In total, 6 out of 11 LTCFs with a high-prevalence outbreak of SARS-CoV-2 infections (≥ 39% infection prevalence), and 12 out of 13 LTCFs with a low prevalence of SARS-CoV-2 infections (≤ 39% infection prevalence) did implement the measure. This results in reduced odds of having a high-prevalence outbreak with the measure in place (OR 0.10, 95% CI 0.01-1.06).

(Continued) Baseline infection control measures were in place in the intervention and the control group.		
Cleaning and environmental hygiene measures Overall implementation and adherence to cleaning and disinfection measures, including training of staff, presence of logs and presence of an infection preventionist **Context** Baseline infection control measures were in place in the intervention and the control group.	**More vs less stringent implementation** Comparison of 13 LTCFs with a low prevalence of SARS-CoV-2 infections (≤ 39%) with those facilities with a high prevalence of 11 SARS-CoV-2 infections (> 39%) on whether they had a higher or a lower cleaning and environmental hygiene measure implementation score (i.e. having more measures implemented). The overall prevalence of SARS-CoV-2 infections in all 24 LTCFs was used as cut-off value for the grouping. Analysis did not adjust for other infection control measures implemented in the facility.	**1. Number of infections** **Size of SARS-CoV-2 outbreak in LTCFs** ***Direction of effect favours the measure (▲)*** The overall cleaning and disinfection implementation score was lower in the 11 facilities with a high number of cases in an outbreak (score: 27%), in comparison with the 13 LTCFs (score: 36%) with a lower number of cases in an outbreak (P = 0.44).
Cleaning frequency Average per day cleaning frequency of high-touch areas. **Context** Baseline infection control measures were in place in the intervention and the control group.	**More vs less stringent implementation** Comparison of 13 LTCFs with a low prevalence of SARS-CoV-2 infections (≤ 39%) with those facilities with a high prevalence of 11 SARS-CoV-2 infections (> 39%) on whether they had a higher or a lower rate of cleaning. The overall prevalence of SARS-CoV-2 infections in all 24 LTCFs was used as cut-off value for the grouping. Analysis did not adjust for other infection control measures implemented in the facility.	**1. Number of infections** **Size of SARS-CoV-2 outbreak in LTCFs** ***Effect in favour of the comparator (▼)*** Across the 24 LTCFs, the mean cleaning frequency per day was 4.5 within LTCFs with a high SARS-CoV-2 prevalence compared to 3.9 within LTCFs with a low SARS-CoV-2 prevalence that had implemented the measure (P = 0.44).
Contact-reduction measures **Resident-focused contact-reduction measures.**	**Measure vs no measure** Comparison of 13 LTCFs with a low prevalence of SARS-CoV-2 (≤ 39%)	**1. Number of infections** **Size of SARS-CoV-2 outbreak in LTCFs** ***Direction of effect favours the measure (▲)*** In total, 7 out of 11 LTCFs with a high-prevalence outbreak of SARS-CoV-2 infections (≥ 39% infection prevalence), and 9 out of 13 LTCFs with a low prevalence

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Implementation of the measure: resident indoor or outdoor activities, including use of physical therapy or gym facilities have been cancelled. **Context** Baseline infection control measures were in place in the intervention and the control group.	infections with those facilities with a high prevalence of 11 SARS-CoV-2 (> 39%) infections on whether they had implemented the measure. The overall prevalence of SARS-CoV-2 in all 24 LTCFs was used as cut-off value for the grouping. Analysis did not adjust for other infection control measures implemented in the facility.	of SARS-CoV-2 infections (≤ 39% infection prevalence) did implement the measure. This results in reduced odds of having a high-prevalence outbreak with the measure in place (OR 0.78, 95% CI 0.14 to 4.27).
Contact-reduction measures **Staff-focused contact reduction measures** Small enclosed areas such as elevators and donning/doffing rooms have signage limiting maximum occupancy **Context** Baseline infection control measures were in place in the intervention and the control group.		**1. Number of infections:** **Size of SARS-CoV-2 outbreak in LTCFs** ***Direction of effect favours the measure (▲)*** In total, 1 out of 10 LTCFs with a high-prevalence outbreak of SARS-CoV-2 infections (≥ 39% infection prevalence), and 7 out of 13 LTCFs with a low prevalence of SARS-CoV-2 infections (≤ 39% infection prevalence) did implement the measure. This results in reduced odds of having a high-prevalence outbreak with the measure in place (OR 0.05, 95% CI 0.00-0.53)
Contact-reduction measures **Staff-focused contact reduction measures** Staff break room is frequently monitored and has adequate space and limited seating to ensure social distancing **Context** Baseline infection control measures were in place in the intervention and the control group.		**1. Number of infections** **Size of SARS-CoV-2 outbreak in LTCFs** ***Direction of effect favours the measure* (▲)** In total, 5 out of 11 LTCFs with a high-prevalence outbreak of SARS-CoV-2 infections (≥ 39% infection prevalence), and 9 out of 13 LTCFs with a low prevalence of SARS-CoV-2 infections (≤ 39% infection prevalence) did implement the measure. This results in reduced odds of having a high-prevalence outbreak with the measure in place (OR 0.28, 95% CI 0.05-1.62)

aOR: adjusted odds ratio; **CI:** confidence interval; **IQR:** interquartile range; **LTCFs:** long-term care facilities; **OR:** odds ratio; **PCR:** polymerase chain reaction; **PPE:** personal protective equipment; **RR:** risk ratio; **SD:** standard deviation; **SE:** standard error

Appendix 12. Surveillance measures: study-by-study results summaries

Intervention category: short description	Comparison: short description and context	Outcome category: description and overview of direction
Delaunay 2020		
Routine testing of residents and staff independent of symptom status Repeated testing of 100% of residents and staff independent of symptoms with a PCR-based test (sensitivity: 90%; turnaround time: immediate) at different rates. **Context** No infection-control measures are described, however basic R number of 3 implies that contact and transmission control measures are in place.	**Higher vs lower rates of testing** Comparison of outcome across 1000 iterations of modelled scenarios with higher rates of testing in comparison with iterations of the scenarios with lower rate of testing.	**1. Number of infections** **Cumulative number of cases at first diagnosis** ***Direction of effect favours higher rates of testing*** The scenario of testing 100% of residents and staff twice a week showed lower mean and median number of cumulative cases across the 1000 iterations of the model (mean: 1.8; median: 1.0; IQR: 1.0) than the scenarios for testing the same population every 14 days (mean: 1.8; median: 1.0; IQR: 1.0) or every 7 days (mean: 3.8; median: 2.0; IQR: 3.0). The scenario of testing 50% of residents and staff twice a week showed lower mean and median number of cumulative cases across the 1000 iterations of the model (mean: 3.2; median: 2.0; IQR: 3.0) than the scenarios of testing the same population once a week (mean: 7.3; median: 4.0; IQR: 5.0).
	Spreading out tests vs conducting tests at one point of time Comparison of outcome across 1000 iterations of modelled scenarios in which the same number of tests is spread out over a period of time in comparison with iterations of the scenario where the same number of tests is conducted at one point in time.	**1. Number of infections** **Cumulative number of cases at first diagnosis** ***Direction of effect favours spreading out tests*** The scenarios of testing 100% of residents and staff every 7 days showed a higher mean and median number of cumulative cases across 1000 iterations of the model (mean: 3.8; median: 2.0; IQR: 3.0) than the scenarios of testing 20% of residents and staff every weekday (mean: 2.8; median: 2.0; IQR: 3.0) and the scenario of testing 14% of residents and staff on a daily basis (mean: 2.7; median: 2.0; IQR: 2.0). The scenarios of testing 100% of residents and staff every 14 days showed a higher mean and median number of cumulative cases across the 1000 iterations of the model (mean: 13.3; median: 5.0; IQR: 9.0) than the scenarios of testing 50% of residents and staff every 7 days (mean: 7.3; median: 4.0; IQR: 5.0).
Holmdahl 2021		
Routine testing of residents and staff independent of symptom status Repeated testing of 100% of residents and staff independent of symptoms with **PCR-based tests** (sensitivity: 100% at a limit of detection of 10^3 viral copies per mL; turnaround time: 48 h) at different rates of testing. **Context** Infected residents are placed in a COVID-19 cohort. Staff in the COV-	**Measure vs no measure** Comparison of the outcome across 100 iterations of the most conservative modelled scenario with the measure (PCR-based testing every 7 days; turnaround time: 48 h; sensitivity: 100%, but depending on a limit of detection of 10^3 viral copies per mL) in comparison with iterations of the scenario without testing.	**1. Number of infections** **Mean cumulative incidence among residents over 3 months** ***Direction of effect favours the measure (▲)*** The scenarios of conducting PCR-based testing of 100% of residents and staff showed a higher mean cumulative incidence among residents across the 100 iterations of the scenario (mean: 26%; SD: 6%) in comparison with the most conservative testing scenario (mean: 17%; SD: 2%) after 3 months of follow-up. All other scenarios with less conservative assumptions about the characteristics of the PCR-test showed an effect in the same direction with a dose-response effect (PCR-based testing 2.3 times per week with a mean cumulative incidence at 3 months of 11% (SD: 3%) and with a mean of 7% (SD: 2%) for conducting daily PCR-based tests).
		1. Number of infections **Mean cumulative incidence among staff over 3 months** ***Direction of effect favours the measure (▲)*** The most conservative scenario of conducting PCR-based testing of 100% of residents and staff showed a higher mean cumulative incidence among staff (of infections originating in the LTCF) across 100 iterations of the scenario

(Continued) ID-19 unit are assumed to properly use PPE, reducing the probability of infection. The mean probability of transmission upon contact implies that baseline transmission-control measures are in place. Residents have reduced contact with residents outside their shared rooms.		(mean: 50%; SD: 6%) in comparison with the most conservative testing scenario (mean: 38%; SD: 5%) after 3 months of follow - up. All other scenarios with less conservative assumptions about the characteristics of the PCR-test showed an effect in the same direction with a dose-response effect (PCR-based testing 2.3 times per week with a mean cumulative incidence at 3 months of 33% (SD: 4%) and with a mean of 31% (SD: 3%) for conducting daily PCR-based tests).
	Higher vs lower rates of testing: Comparison of the outcome across 100 iterations of the modelled scenario with the highest rate of PCR-based testing (testing daily) in comparison with iterations of the scenario with lower rates of testing (testing 2.3 times and once a week) with other testing characteristics being equal.	1.**Number of infections:** **Mean cumulative incidence among residents over 3 months** ***Direction of effect favours testing at higher rates*** The scenario with the highest rate of PCR-based testing of residents and staff (testing daily) showed a lower mean cumulative incidence among residents across 100 iterations of the scenario (mean: 7%; SD: 2%) in comparison with the scenarios of testing at the lower rates of 2.3 times per week (mean: 11%; SD: 3%) and testing once per week (mean: 26%; SD: 6%) after 3 months of follow-up.
		1. Number of infections **Mean cumulative incidence among staff over 3 months** ***Direction of effect favours testing at higher rates*** The scenario with the highest rate of PCR-based testing of residents and staff (testing daily) showed a lower mean cumulative incidence among staff across 100 iterations of the scenario (mean: 31%; SD: 3%) in comparison with the scenarios of testing at the lower rates of 2.3 times per week (mean: 33%; SD: 4%) and testing once per week (mean: 38%; SD: 5%) after 3 months of follow-up.
Routine testing of residents and staff independent of symptom status Repeated testing of 100% of residents and staff independent of symptoms with **antigen-based tests** (sensitivity: 100% at a limit of detection of 10^5 viral copies per mL; turnaround time: immediate) at different rates of testing. **Context** Infected residents are placed in a COVID-19 unit. Staff in the COVID-19 unit are assumed to properly use PPE, reducing the probability of infection. The mean probability of transmission upon contact implies that baseline transmission-control	**Measure vs no measure** Comparison of the outcome across 100 iterations of the most conservative scenario with antigen-based testing (rate: every 7 days; turnaround time: immediate; sensitivity: 100%, but depending on a limit of detection of 10^5 viral copies per mL) in comparison with iterations of the scenario with no measure.	**1. Number of infections** **Mean cumulative incidence among residents over 3 months** ***Direction of effect favours the measure (▲)*** The most conservative scenario of conducting antigen-based testing of 100% of residents and staff showed a higher mean cumulative incidence among residents across 100 iterations of the scenario (mean: 26%; SD: 6%) in comparison with the most conservative testing scenario (mean: 12%; SD: 4%) after 3 months of follow-up. All other scenarios with less conservative assumptions about the characteristics of the antigen test showed an effect in the same direction with a dose-response effect (antigen-based testing 2.3 times per week with a mean cumulative incidence at 3 months of 8% (SD: 3%) and with a mean of 4% (SD: 2%) for conducting daily antigen-based tests).
		1. Number of infections **Mean cumulative incidence among staff over 3 months** ***Direction of effect favours the measure (▲)*** The most conservative scenario of conducting antigen-based testing of 100% of residents and staff showed a higher mean cumulative incidence among staff (of infections originating in the LTCF) across 100 iterations of the scenario (mean: 50%; SD: 6%) in comparison with the scenario without testing (mean: 34%; SD: 4%) after 3 months of follow-up. All other scenarios with less conservative assumptions about the characteristics of the antigen test showed an effect in the same direction with a dose-response effect (antigen-based testing 2.3 times per week with a mean cumulative incidence at 3 months of 32% (SD: 3%) and with a mean of 29% (SD: 3%) for conducting daily antigen-based tests).

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measures are in place. Residents have reduced contact with residents outside their shared rooms.	**Higher vs lower rates of testing** Comparison of cumulative incidence of cases among residents and among staff at 3 months across 100 iterations of the modelled scenario with the lowest rate of testing in comparison with the iterations of the scenario with higher rates of testing (with other testing characteristics being equal).	**1. Number of infections** **Mean cumulative incidence among residents over 3 months** ***Direction of effect favours higher rates of testing*** The scenario with the highest rate of antigen-based testing of 100% of residents and staff (testing daily), showed a lower mean cumulative incidence among residents across 100 iterations of the scenario (mean: 4%; SD: 2%), in comparison with the scenarios of testing at the lower rates of 2.3 times per week (mean: 8%; SD: 3%) and testing once per week (mean: 12%; SD: 4%) after 3 months of follow-up. **1. Number of infections** **Mean cumulative incidence among staff over 3 months** ***Direction of effect favours higher rates of testing*** The scenario with the highest rate of POC-based testing of 100% of residents and staff (testing daily), showed a lower mean cumulative incidence among staff across 100 iterations of the scenario (mean: 29%; SD: 3%), than the scenarios of testing at the lower rates of 2.3 times per week (mean: 32%; SD: 3%) and testing once per week (mean: 34%; SD: 4%) after 3 months of follow-up.
	Testing residents and staff vs testing staff only Comparison of cumulative incidence of cases among residents and staff at 3 months across 100 iterations of the modelled scenario of testing residents and staff in comparison with the iterations of the scenario with testing staff only (with other testing characteristics being equal).	**1. Number of infections** **Mean cumulative incidence among residents over 3 months** ***Direction of effect favours testing residents and staff*** Testing 100% of residents and staff showed a lower mean cumulative incidence among residents across 100 iterations of the scenario of testing once per week in comparison with the scenarios of testing staff only at rates of once per week (mean: 12% (SD: 4%) vs 14% (SD: 5%)), 2.3 times per week (mean: 8% (SD: 3%) vs 9% (SD: 3%)) and testing daily (mean: 4% (SD: 2%) vs 5% (SD: 2%)) after 3 months of follow-up.
		1. Number of infections **Mean cumulative incidence among staff over 3 months** ***Direction of effect favours testing residents and staff*** Testing 100% of residents and staff showed a lower mean cumulative incidence among staff-members across 100 iterations of the scenario of testing once per week in comparison with the scenarios of testing staff only at rates of once per week (mean: 34% (SD: 4%) vs 38% (SD: 4%)), at 2.3 times per week (mean: 32% (SD: 3%) vs 35% (SD: 4%)) and at testing daily (mean: 29% (SD: 3%) vs 31% (SD: 3%)) after 3 months of follow-up.
Routine testing of residents and staff independent of symptom status Repeated testing of 100% of residents and staff independent of symptoms with antigen-based tests or with PCR-based tests at different rates of testing **Context**	**PCR-based testing vs POC-based testing** Comparison of the outcome across 100 iterations of the modelled scenario of testing residents and staff with PCR-based tests (sensitivity: 100% at a limit of detection of 10^3 viral copies per mL; turnaround time: 48 h) in comparison with the iterations of the scenario with antigen-based	**1. Number of infections** **Mean cumulative incidence among residents over 3 months** ***Direction of effect favours testing with antigen-based tests*** Testing 100% of residents and staff with PCR-based tests showed a higher mean cumulative number of infections among residents across 100 iterations of the scenario in comparison with the scenarios of testing with antigen-based tests, at rates of once per week (mean: 17% (SD: 6%) vs 12% (SD: 4%)), 2.3 times per week (mean: 11% (SD: 3%) vs 8% (SD: 3%)), and testing daily (mean: 7% (SD: 2%) vs 4% (SD: 2%)) after 3 months of follow-up.
		1. Number of infections **Mean cumulative incidence among staff over 3 months**

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Infected residents are placed in a COVID-19 cohort. Staff in the COVID-19 unit are assumed to properly use PPE, reducing the probability of infection. The mean probability of transmission upon contact implies that baseline transmission control measures are in place. Residents have reduced contact with residents outside their shared rooms.	tests (sensitivity: 100% at a limit of detection of 10^5 viral copies per mL; turnaround time: immediate) at the same rate of testing.	***Direction of effect favours testing with antigen-based tests*** Testing 100% of residents and staff with PCR-based tests showed a higher mean cumulative number of infections among staff across 100 iterations of the scenario in comparison with the scenarios of testing with antigen-based tests at rates of once per week (mean: 38% (SD: 5%) vs mean: 34% (SD: 4%)), 2.3 times per week (mean: 33% (SD: 4%) vs mean: 32% (SD: 3%)), and testing daily (mean: 31% (SD: 3%) vs mean: 29% (SD: 3%)) after 3 months of follow-up.

Nguyen 2020

Routine testing of residents and staff independent of symptom status **Weekly PCR-based testing** of 100% of residents or staff independent of symptoms with PCR-based tests (test sensitivity: 70%, turnaround time: 1 day) **Context** Baseline control measures in place are the isolation of symptomatic cases and testing of new admissions (2 tests), social distancing and restricted visiting.	**Measure vs no measure** Comparison of the outcome across 100 iterations of the most conservative scenario of testing residents and staff (rate: weekly testing, test sensitivity: 70%, turnaround time: 1 day) and a scenario without the measure (but with basic infection control measures in place)	**1. Number of infections** **Cumulative number of infections among residents over 90 days** ***Direction of effect favours the measure (▲)*** Weekly surveillance testing of 100% of residents and staff showed lower mean and median cumulative infections among residents across 100 iterations of the scenario with the measure (mean: 31/80 residents, median: 31/80; IQR: 27-36) in comparison with the scenario without the measure (mean: 53/80 residents, median: 53/80; IQR: 49-57) after a follow-up of 90 days. The difference of mean values was significant, the exact value was not provided.
Routine testing of residents and staff independent of symptom status **Weekly PCR-based testing** of 100% of residents or staff independent of symptoms with PCR-based tests (test sensitivity: 70%, turnaround time: 1 day) **Context** Baseline control measures in place are the isolation of symptomatic cases and testing of new admissions (2 tests), social distancing and restricted visiting.	**Testing of residents and staff vs testing of staff** Comparison of the outcome across 100 iterations of a scenario with weekly PCR-based testing of residents and staff, in comparison with testing of staff only at the same rate.	**1. Number of infections** **Cumulative number of infections among residents over 90 days** ***Direction of effect favours testing of residents and staff*** Weekly surveillance testing of 100% of residents and staff showed lower mean and median cumulative infections among residents across 100 iterations of the scenario with the measure (mean: 31/80 residents, median: 31/80; IQR: 27-36) in comparison with the scenario of weekly testing of staff only (mean: 32/80 residents, median: 32/80; IQR: 28-36) after a follow-up of 90 days. The 95% CI of the difference: −0.1 to 1.8, P value: 1 (Welch's t-test; 2 tailed; including Bonferroni correction).

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Routine testing of residents and staff independent of symptom status **Weekly PCR-based testing** of residents or staff independent of symptoms (test sensitivity: 70%, turnaround time: 1 day) **Context** Baseline control measures in place are the isolation of symptomatic cases and testing of new admissions (2 tests), social distancing and restricted visiting.	**Testing of residents and staff vs testing of residents** Comparison of the outcome across 100 iterations of a scenario with testing of residents and staff, in comparison with testing of residents only	**1. Number of infections** **Cumulative number of infections among residents over 90 days** ***Direction of effect favours testing of residents and staff*** Weekly surveillance testing of residents and staff showed lower mean and median cumulative infections among residents across 100 iterations of the scenario with the measure (mean: 31/80 residents, median: 31/80; IQR: 27-36) in comparison with the scenario of weekly testing of residents only (mean: 53/80 residents, median: 53/80; IQR: 49-57) after a follow-up of 90 days. Significant difference of mean, exact value not provided.
Routine testing of residents and staff independent of symptom status **PCR-based testing** of 100% of staff at different rates independent of symptoms (test sensitivity: 70%, turnaround time: 1 day) **Context** Baseline control measures in place are the isolation of symptomatic cases and testing of new admissions (2 tests), social distancing and restricted visiting.	**Higher vs lower rates of testing** Comparison of the outcome in 100 iterations of scenarios with higher rates of testing of staff in comparison with lower rates of testing.	**1. Number of infections** **Cumulative number of infections among residents over 90 days** ***Direction of effect favours higher rates of testing*** Weekly surveillance testing of 100% of residents and staff (as the scenario with the highest rate of testing of residents and staff) showed a lower mean and median of the cumulative number of infections among residents across 100 iterations of the scenario with the measure (mean: 31/80 residents, median: 31/80; IQR: 27-36) in comparison with the scenario with the lowest rate of testing (testing every 30 days) (mean: 50/80 residents, median: 50/80; IQR: 46-54) after a follow-up of 90 days. The scenarios with rates of testing in between testing 100% of staff every 20 days (mean: 47/80 residents, median: 47/80; IQR: 43-51) and every 14 days (mean: 44/80 residents, median: 44/80; IQR: 40-48) showed an effect in the same direction with a dose-response relationship.
Routine testing of residents and staff independent of symptom status **Weekly PCR-based testing** of different proportions of staff independent of symptoms (test sensitivity: 70%, turnaround time: 1 day) **Context** Baseline control measures in place are the isolation of symptomatic cases and testing of new admissions (2 tests), social distancing and restricted visiting.	**Higher vs lower rates of testing** Comparison of the outcome in 100 iterations of scenarios with higher population proportions of staff being tested weekly (100%) in comparison with lower rates of testing (25%, 50%, 75%)	**1. Number of infections** **Cumulative number of infections among residents over 90 days** ***Direction of effect favours higher rates of testing*** Weekly surveillance testing of 100% of staff (as the scenario with the highest population proportion for weekly testing of staff) showed lower mean and median infections among residents across 100 iterations of the scenario with the measure (mean: 31/80 residents, median: 31/80; IQR: 27-36) in comparison with the scenario with the lowest proportion of staff being tested at the same rate (weekly testing of 25% of staff) (mean: 49/80 residents, median: 49/80; IQR: 46-53), after a follow-up of 90 days. The scenarios in which the proportion of the population being tested is between these two scenarios — testing of 75% of staff (mean: 38/80 residents, median: 38/80; IQR: 34-42) and of testing 50% of staff (mean: 43/80 residents, median: 43/80; IQR: 39-48) — showed an effect in the same direction with a dose-response effect.

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Routine testing of residents and staff independent of symptom status **PCR-based testing** of 100% of residents in different rates independent of symptoms (test sensitivity: 70%, turnaround time: 1 day) **Context** Baseline control measures in place are the isolation of symptomatic cases and testing of new admissions (2 tests), social distancing and restricted visiting.	**Higher vs lower rates of testing** Comparison of the outcome in 100 iterations of scenarios with higher rates of testing of residents (daily testing) in comparison with lower rates of testing (weekly testing).	**1. Number of infections** **Cumulative number of infections among residents over 90 days** ***Direction of effect favours higher rates of testing*** Daily surveillance testing of 100% of residents (as the scenario with the highest rate of testing of residents) showed lower mean and median cumulative infections among residents across 100 iterations of the scenario with the measure (mean: 52/80 residents, median: 52/80; IQR: 48-55) in comparison with the scenario with the lowest rate of testing (weekly testing days) (mean: 53/80 residents, median: 53/80; IQR: 49-57) after a follow-up of 90 days.

See 2020

Routine testing of residents and staff independent of symptom status **PCR-based testing** of 100% of staff independent of symptoms at different rates of testing (every 7 days and every 3 days; peak sensitivity: 95%; turnaround time 24 h or 48 h) **Context** Reproduction value of the infection in the LTCF in an outbreak scenario is assumed to be 1.4, which implies that strong baseline infection control measures are in place. Symptomatic residents and staff are tested and isolated. Model assumes serial testing of asymptomatic people in response to an outbreak at the same rate as the surveillance testing.	**Measure vs no measure** Comparison of outcomes in the scenario with the most conservative version of testing (testing every 7 days; peak sensitivity: 95%; turnaround time 48 h) in comparison with a scenario without the measure.	**Number of infections** **Mean number of cases per outbreak** ***Direction of effect favours the measure (▲)*** The most conservative version of the measure of surveillance testing (testing every 7 days; peak sensitivity: 95%; turnaround time 48 h) showed a reduction in the mean number of cases in outbreaks by 61.9% across the iterations of the scenario with the measure in comparison with the baseline scenario without the measure (which showed a mean number of 50 cases per outbreak).
	Higher vs lower rates of testing Comparison of outcomes across iterations of scenarios with the highest rate of PCR-based testing (testing every 3 days) in comparison with the scenario of the lowest rate of testing (every 7 days) with all other test characteristics being equal.	**Number of infections** **Mean number of cases per outbreak** ***Direction of effect favours higher rates of testing*** Surveillance testing with the highest rates of PCR-based testing of staff (testing every 3 days) showed a higher proportion of cases prevented through the measure in comparison with the baseline scenario across the iterations of the model than the scenarios of testing at the lowest rate (weekly testing) for both a turnaround time of 48 h (−85.9% vs −61.9%) and of 24 h (−92.8% vs −75.3%). The baseline scenario without testing showed a mean number of 50 cases per outbreak.
	Higher vs lower turnaround time Comparison of outcomes across iterations of scenarios with the lowest turnaround time (24 h) in comparison with the scenarios with the highest turnaround time (48 h) with all oth-	**Number of infections** **Mean number of cases per outbreak** ***Direction of effect favours lower turnaround times of PCR-tests*** Surveillance testing with the lowest turnaround time rates of PCR-based testing of staff (24 h) showed a higher proportion of cases prevented through the measure in comparison with the baseline scenario across the iterations of the model than the scenarios of testing with a higher turnaround time (48 h) for both a rate of weekly testing (−75.3% vs −61.9%) and for testing every 3 days (−92.8% vs −85.9%).

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	er test characteristics being equal.	The baseline scenario without testing showed a mean number of 50 cases per outbreak.
Routine testing of residents and staff independent of symptom status **Antigen-based testing** of 100% of staff independent of symptoms at different rates of testing (every 7 days, every 3 days, or every day; peak sensitivity: 81% or 48%; turnaround time: immediate). **Context** Reproduction value of the infection in the LTCF in an outbreak scenario is assumed to be 1.4, which implies that strong baseline infection control measures are in place. Symptomatic residents and staff are tested and isolated. Model assumes serial testing of asymptomatic people in response to an outbreak at the same rate as the surveillance testing.	**Higher vs lower rates of testing** Comparison of outcomes across iterations of the model with the highest rate of antigen-based testing (testing every day) in comparison with the scenario of lower rates of testing (every 3 days and every 7 days) with all other test characteristics being equal.	**Number of infections** **Mean number of cases per outbreak** ***Direction of effect favours higher rates of testing*** Surveillance testing of staff with the highest rates of antigen-based testing at a test sensitivity of 48% (testing every 3 days) showed a higher proportion of cases prevented through the measure in comparison with the baseline scenario across the iterations of the model than the scenarios of testing at the lower rates of testing every 3 days for both a test sensitivity of 48% (−86.2% vs −58.6%) and of 81% (−94.8% vs −80.1%). The scenario of antigen-based testing daily (test sensitivity: 48%) showed an effect in the same direction with a dose-response effect (−97.1%). The baseline scenario without testing showed a mean number of 50 cases per outbreak.
	Higher vs lower sensitivity of testing Comparison of outcomes across iterations of the model with the highest sensitivity of antigen-based tests (81%) in comparison with the scenario of lower rates of testing (48%) with all other test characteristics being equal.	**Number of infections** **Mean number of cases per outbreak** ***Direction of effect favours lower turnaround times of PCR-tests*** Surveillance testing of staff with antigen-based tests with the highest sensitivity (81%) showed a higher proportion of cases prevented through the measure in comparison with the baseline scenario across the iterations of the model than the scenarios with lower test sensitivity (48%) for both a rate of weekly testing (−80.1% vs −58.6%) and for testing every 3 days (−94.8% vs −86.2%). The baseline scenario without testing showed a mean number of 50 cases per outbreak.
Routine testing of residents and staff independent of symptom status **PCR-based or antigen-based testing** of 100% of staff independent of symptoms at different rates of testing (every 7 days, every 3 days, or every day; peak sensitivity: 95%, 81% or 48%; turnaround time: 48 h, 24 h, and immediate) **Context** Reproduction value of the infection in the LTCF in an outbreak scenario is assumed to be 1.4, which implies that strong baseline infection control measures are in place. Sympto-	**PCR- vs antigen-based testing** Comparison of the outcome across iterations of scenarios of PCR-based serial testing (sensitivity: 95%, turnaround time: 24 h/48 h) in comparison with an antigen-based test (sensitivity: 48% and 81%; turnaround time: immediate)	**Number of infections** **Mean number of cases per outbreak** ***The comparison of PCR-based testing and antigen-based testing showed mixed effects*** The scenarios of surveillance testing of staff with PCR-based tests showed mixed results regarding the outcome of cases per outbreak prevented through the measure in comparison with the scenarios of antigen-based testing. For weekly testing, PCR-based testing with a turnaround time of 48 h led to a reduction of 61.9% and with a turnaround time of 24 h a reduction of 75.3%, while antigen-based testing with a sensitivity of 81% showed a reduction of 80.1% and for a sensitivity of 48% showed a reduction of 58.6%. For testing every 3 days, PCR-based testing with a turnaround time of 48 h led to a reduction of 85.9% and with a turnaround time of 24 h a reduction of 92.8%, while antigen-based testing with a sensitivity of 81% showed a reduction of 94.8% and for a sensitivity of 48% showed a reduction of 86.2%. The baseline scenario without testing showed a mean number of 50 cases per outbreak.

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matic residents and staff are tested and isolated. Assumption of serial testing of asymptomatic people in response to an outbreak.		

Smith 2020a

Symptom-based surveillance All individuals with mild or moderate COVID-19-like symptoms (in addition to those with severe symptoms) are tested with a PCR-based test (peak sensitivity: 80%, turnaround time: 24 h). **Context** Modelled facility with 170 residents and 240 staff. Assumed basic reproduction number implies that baseline infection control measures are in place. Residents and staff with severe COVID-19-like symptoms are tested with a PCR-test.	**Higher vs lower levels of implementation** Comparison of the median outcome across 100 iterations of a scenario with testing for all levels of severity of individuals with COVID-19-like symptoms and testing only individuals with severe symptoms.	**1. Number of infections** **Number of infections upon detection of outbreak** ***Direction of effect favours the measure (▲)*** The median number of infections among residents upon detection of an outbreak across the 100 iterations of the model, was higher in the scenario without the measure (median: 26 cases/410 residents and staff, 95% interval: 1 to 116), in comparison with the scenario with the measure (median: 7/410, 95% interval: 1 to 35). **3. Outbreak prevention** **Probability of detecting outbreak prior to a second case in the facility** ***Direction of effect favours the measure (▲)*** The rate of scenarios in which an outbreak was detected prior to a second case in the facility across the 100 iterations of the scenarios, was lower in the scenario with testing for severe symptoms only (4% of scenarios), in comparison with the scenario of testing in the case of any COVID-19-like symptom (15% of scenarios).
Routine testing of residents and staff independent of symptom status Serial testing of a random sample of residents and staff independent of symptom status with a PCR-based test (peak sensitivity: 80%, turnaround time: 24 h) **Context** Modelled facility with 170 residents and 240 staff. Model assumes limited baseline control measures in place. Residents and staff with COVID-19-like symptoms of any severity are tested with a PCR-test.	**Measure vs no measure** Comparison of the median outcome across 100 iterations of the most conservative scenario with the measure in place (16 PCR tests available per day) in comparison with a scenario with symptom-based testing only. Scenarios assume 4-5 individuals showing COVID-19-like but not COVID-19-related symptoms. Measure scenario assumes that after testing individuals with COVID-19-like symptoms, the remaining tests are used for testing a random set of patients and staff (i.e.	**1. Number of infections** **Number of infections upon detection of outbreak** ***Direction of effect favours the measure (▲)*** The median number of infections among residents upon detection of an outbreak across the 100 iterations of the model, was higher in the scenario without the measure (median: 7 cases/410 residents and staff, 95% interval: 1 to 33), in comparison with the scenario with the measure (median: 5/410, 95% interval: 1 to 29).

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	11-12 tests per 410 individuals).	
Routine testing of residents and staff independent of symptom status Serial testing of all residents and staff independent of symptom status with a pooled PCR-based test (peak sensitivity: approximately 60%, turnaround time: 24 h) **Context** Modelled facility with 170 residents and 240 staff. Model assumes limited baseline control measures in place. Residents and staff with COVID-19-like symptoms of any severity are tested with a PCR-test.	**Measure vs no measure** Comparison of the median outcome across 100 iterations of the most conservative scenario with the measure in place (daily pooled PCR testing of 100% of residents and staff with a pooled PCR test (reduced sensitivity) in comparison with a scenario with symptom-based testing only).	**3. Outbreak prevention** **Probability of detecting outbreak prior to a second case in the facility** ***Direction of effect favours the measure (▲)*** The proportion of scenarios in which an outbreak was detected prior to a second case in the facility across the 100 iterations of the scenarios was lower in the scenario without the measure (4% of scenarios) in comparison with the scenario of daily pooled PCR testing (11% of scenarios).
Routine testing of residents and staff independent of symptom status Serial testing of a random sample of residents and staff independent of symptom status with a PCR-based test (peak sensitivity: 80%, turnaround time: 24 h) **Context** Modelled facility with 170 residents and 240 staff. Model assumes limited baseline control measures in place. Residents and staff with COVID-19-like symptoms of any severity are tested with a PCR-test.	**Higher vs lower rates of testing** Comparison of the median outcome across 100 iterations of a scenario with lower rates of testing daily (16 PCR tests available per day for 410 individuals) in comparison with a scenario with higher rates of testing daily (32 PCR tests available per day for 410 individuals). Scenarios assume that 4-5 individuals per day show any symptoms. After testing individuals with COVID-19-like symptoms, the remaining tests are used for testing a random set of patients and staff (i.e. 11-12 tests and 27-28 tests per 410 individuals/day).	**1. Number of infections** **Number of infections upon detection of outbreak** ***Direction of effect favours higher rates of testing*** The median number of infections among residents upon detection of an outbreak across the 100 iterations of the model was lower in the scenario with higher rates of testing (median: 5 cases/410 resident sand staff, 95% interval: 1 to 22) in comparison with the scenario with lower rates of testing (median: 5/410, 95% interval: 1 to 29).
Routine testing of residents and staff independent of symptom status	**Higher vs lower test sensitivity** Comparison of the median outcome across 100 iterations of sce-	**1. Number of infections** **Number of infections upon detection of outbreak** ***Direction of effect favours higher test sensitivity***

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Serial testing of a random sample of residents and staff independent of symptom status with a PCR-based test (turnaround time: 24 h) **Context** Modelled facility with 170 residents and 240 staff. Assumed basic reproduction number implies that baseline infection control measures are in place. Residents and staff with severe COVID-19-like symptoms are tested with a PCR-test.	narios with 16 and 32 tests for 410 residents and staff per day of a scenario with lower test sensitivity (peak sensitivity: 80%) and a scenario with a higher test sensitivity (peak sensitivity: 90%)	For 16 tests per 410 residents and staff, the median number of infections among residents and staff upon detection of an outbreak across the 100 iterations of the model was higher in the scenario with lower test sensitivity (median: 5 cases/410 residents and staff, 95% interval: 1 to 29), in comparison with the scenario with higher test sensitivity measure (median: 4/410, 95% interval: 1 to 22). For 32 tests per 410 residents and staff, the median number of infections among residents and staff upon detection of an outbreak across the 100 iterations of the model was higher in the scenario with lower test sensitivity (median: 4 cases/410 residents and staff, 95% interval: 1 to 22) in comparison with the scenario with higher test sensitivity measure (median: 3/410, 95% interval: 1 to 13).
Symptom-based surveillance All individuals with mild or moderate COVID-19-like symptoms (in addition to those with severe symptoms) are tested with a PCR-based test (peak sensitivity: 80%, turnaround time: 24 h) **Context** Modelled facility with 30 geriatric residents and 44 staff. Assumed basic reproduction number implies that baseline infection control measures are in place. Residents and staff with severe COVID-19-like symptoms are tested with a PCR-test.	**Higher vs lower levels of implementation** Comparison of the median outcome across 100 iterations of a scenario with testing for all levels of severity of individuals with COVID-19-like symptoms and testing individuals with severe symptoms only.	**1. Number of infections** **Number of infections upon detection of outbreak** ***Direction of effect favours the measure (▲)*** The median number of infections among residents upon detection of an outbreak across the 100 iterations of the model was higher in the scenario without the measure (median: 19 cases/74 residents and staff, 95% interval: 1 to 44 cases) in comparison with the scenario with the measure (median: 4 /74, 95% interval: 1 to 27).
Routine testing of residents and staff independent of symptom status Serial testing of a random sample of residents and staff independent of symptom status with a PCR-based	**Measure vs no measure** Comparison of the median outcome across 100 iterations of the most conservative scenario with the measure in place (4 PCR tests available for general	**1. Number of infections** **Number of infections upon detection of outbreak** ***Direction of effect favours the measure (▲)*** The median number of infections among residents upon detection of an outbreak across the 100 iterations of the model was higher in the scenario without the measure (median: 4 cases/74 residents and staff, 95% interval: 1 to 25 cases) in comparison with the scenario with the measure (median: 3/74, 95% interval: 1 to 22).

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test (peak sensitivity: 80%, turnaround time: 24 h) **Context** Modelled facility with 30 geriatric residents and 44 staff. Model assumes limited baseline control measures in place. Residents and staff with COVID-19-like symptoms of any severity are tested with a PCR test.	testing per day) in comparison with a scenario with symptom-based testing only. Scenarios assume that on average 0-1 individuals showing COVID-19-like but not COVID-19-related symptoms. Measure scenario assumes that after testing individuals with COVID-19-like symptoms, the remaining tests are used for testing a random set of patients and staff (i.e. 3-4 test per 74 individuals).	
Routine testing of residents and staff independent of symptom status Serial testing of a random sample of residents and staff independent of symptom status with a PCR-based test (peak sensitivity: 80%, turnaround time: 24 h) **Context** Modelled facility with 30 geriatric residents and 44 staff. Model assumes limited baseline control measures in place. Residents and staff with COVID-19-like symptoms of any severity are tested with a PCR test.	**Higher vs lower rates of testing** Comparison of the median outcome across 100 iterations of a scenario with lower rates of testing daily (4 PCR tests available per day for 74 individuals) in comparison with a scenario with higher rates of testing daily (32 PCR tests available per day for 74 individuals). All scenarios assume that on average 0-1 individuals per day show any symptoms. After testing individuals with COVID-19-like symptoms, the remaining tests are used for testing a random set of patients and staff (i.e. 3-4 tests and 31-32 tests per 74 individuals per day).	**1. Number of infections** **Number of infections upon detection of outbreak** ***Direction of effect favours higher rates of testing*** The median number of infections among residents upon detection of an outbreak across the 100 iterations of the model was lower in the scenario with higher rates of testing (32 tests per day) (median: 1 case/74 residents and staff, 95% interval: 1 to 7), in comparison with the scenario with lower rates of testing of 16 tests per day (median: 2/74, 95% interval: 1 to 9), 8 tests per day (median: 2 /74, 95% interval: 1 to 15), and 4 tests per day (median: 3 /74, 95% interval: 1 to 22).
Telford 2021		
Symptom-based surveillance Temperature and symptoms of residents and members of staff are screened regularly, and logs are kept and analysed for daily trends. **Context**	**Measure vs no measure** Comparison of 13 LTCFs with a low prevalence of SARS-CoV-2 (≤ 39% infections) with 11 facilities with a high prevalence of SARS-CoV-2 (> 39% infections) on whether they had implemented the measure. The overall preva-	**1. Number of infections** **Size of SARS-CoV-2 outbreak in LTCFs** ***Direction of effect favours the measure* (▲)** In total, 3 out of 11 LTCFs with a high-prevalence outbreak of SARS-CoV-2 (≥ 39% infection prevalence), and 8 out of 13 LTCFs with a low prevalence of SARS-CoV-2 (≤ 39% infection prevalence) did implement the measure. This results in reduced odds of having a high-prevalence outbreak with the measure in place (OR 0.23, 95% CI 0.04-1.33).

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Baseline infection control measures were in place in the intervention and the control group.	lence of SARS-CoV-2 in all 24 LTCFs was used as cut-off value for the grouping. Analysis did not adjust for other infection control measures implemented in the facility.	

Telford 2020

Routine testing of residents and staff independent of symptom status Nasopharyngeal swab samples were collected and analysed using RT-PCR before or while SARS-CoV-2 outbreak.	**Measure vs another measure** Comparison of LTCFs using reactive generalised testing and LTCFs with preventive testing; with data from 28 LTCFs In this analysis, LTCFs in the control group (n = 15) were compared to those facilities in the intervention group with at least one case (n = 8/13).	**1. Number of infections** **Number of SARS-CoV-2 infections among residents** ***Direction of effect favours the measure* (▲)** The median attack rate among residents in the facilities was 42% in the control group (range: 79.4% to 12.8%) and 1.5% in the intervention group (range: 3.8% to 0%). The difference in medians was significant in a two-tailed median test (P value: < 0.01). In the 15 LTCFs in the control group, in total 723 cases out of 1705 residents (42%) were identified through mass screening and 4 weeks of symptom-based screening. This corresponds to 17 cases out of the 919 residents (2%) in the 8 LTCFs in the intervention group with at least 1 case.
		1. Number of infections **Number of SARS-CoV-2 infections among members of staff** ***Direction of effect favours the measure* (▲)** The median attack rate among staff per facility was 9.4% in the control group (range: 55.4% to 1.2%); and 0.5% in the intervention group (range: 13.2% to 0%). The difference in medians was significant in a two-tailed median test (P value: < 0.01). In the 15 LTCFs in the control group, in total 230 cases out of 1944 staff (12%) were identified through mass screening and 4 weeks of symptom-based screening. This corresponds to 15 cases out of 697 staff (2%) in the 8 facilities in the intervention group with at least 1 case.
		4. COVID-19-related hospitalisations **Number and proportion of hospitalisations among residents** ***Direction of effect favours the measure* (▲)** The median hospitalisation rate among residents in the facilities was 7.4% in the control group (range: 79.4% to 12.8%) and 1.05% in the intervention group (range: 27.0% to 2.0%). The difference in medians was significant in a two-tailed median test (P value: < 0.01). In the 15 LTCFs in the control group, in total, 144 hospitalisations among residents out of 1705 residents (20%) were registered in the 4 weeks after the generalised testing in the facility. This corresponds to 5 hospitalisations among the 919 residents (0.5%) in the 8 facilities in the intervention group with at least 1 case.
		4. COVID-19-related hospitalisations **Number and proportion of hospitalisations among members of staff** ***Direction of effect favours the measure* (▲)** The median hospitalisation rate among staff in the facilities was 0% in the control group (range: 7.4% to 0%) and 0% in the intervention group (range: 1.0%

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		to 0%). The difference in medians was significant in a two-tailed median test (P value: < 0.01). In the 15 LTCFs in the control group, in total 14 hospitalisations among staff out of 1944 staff (0.7%) were registered in the 4 weeks after the generalised testing in the facility. This corresponds to 5 hospitalisations among the 697 staff (2%) in the 8 facilities in the intervention group with at least 1 case.
		5. Number of deaths **Number and proportion of deaths among residents** ***Direction of effect favours the measure* (▲)** The median mortality rate among residents in the facilities was 5.3% in the control group (range: 23.8% to 0.9%) and 0% in the intervention group (range: 11.5% to 0%). The difference in medians was significant in a two-tailed median test (P value: < 0.01). In the 15 LTCFs in the control group, 109 deaths among residents among the 1705 residents (15%) were registered in the control group in the 4 weeks after the generalised testing in the facility. This corresponds to 3 deaths among the 919 residents (0.3%) in the 8 facilities in the intervention group with at least 1 case.
		5. Number of deaths **Number and proportion of deaths among members of staff** ***Direction of effect favours the comparator (▼)*** None of the 15 facilities in the control group registered a death among staff, while 1 facility in the intervention group registered 1 death among staff. The median mortality rate among staff in the facilities was 0% in the control group (range: 0% to 0%) and 0% in the intervention group (range: 1% to 0%). The difference in medians was significant in a two-tailed median test (P value: < 0.01). In the 15 LTCFs in the control group, 0 deaths among the 1944 staff (0%) were registered in the control group in the 4 weeks after the generalised testing in the facility. This corresponds to 1 death among the 697 staff (0.1%) in the 8 facilities in the intervention group with at least 1 case.
Tsoungui 2021		
Routine testing of residents and staff independent of symptom status Serial testing in the form of conducting PCR-based tests on 100% of staff every 14 days (most conservative scenario; peak sensitivity: 80%; turnaround time: 48 h) **Context** Basic reproduction number implies baseline infection control measures in place. Symptom-based screening (individuals in symptomatic stage of the disease are de-	**Measure vs no measure** Comparison of the outcome in scenarios with the measure in its most conservative form of implementation (testing every 14 days) with a scenario without the measure.	**5. Number of deaths** **Cumulative number of deaths among residents after 550 days** ***Direction of effect favours the measure (▲)*** The cumulative number of deaths among residents was higher in the scenario without the measure (1410 deaths/100,000 residents), in comparison with the scenario with the most conservative form of surveillance testing (defined through the lowest rate of testing every 14 days; 1180 deaths/100,000 residents). The scenarios with higher rates of testing showed an effect in the same direction with a dose-response effect: testing every 7 days: 1050/100,000; testing every 5 days: 990/100,000; testing every 2 days: 830/100,000; and testing every day: 760/100,000. (Data extracted from plots.)
		5. Number of deaths **Cumulative number of deaths among staff after 550 days** ***Direction of effect favours the measure (▲)*** The cumulative number of deaths among staff was higher in the scenario without the measure (135 deaths/100,000 staff) in comparison with the scenario with the most conservative form of surveillance testing (defined through the lowest rate of testing every 14 days; 120 deaths/100,000 staff). The scenarios with higher rates of testing showed an effect in the same direction with

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tected and isolated). Isolated individuals are assumed to have a reduced transmission probability. Model assumes a 'lockdown' scenario in the general population (contact reduction within the population).		a dose-response effect: testing every 7 days: 110/100,000; testing every 5 days: 105/100,000; testing every 2 days: 95/100,000; and testing every day: 90/100,000. (Data extracted from plots.)
Routine testing of residents and staff independent of symptom status Serial testing in the form of conducting antigen-based tests on 100% of staff every 2 days (only scenario; peak sensitivity: 85%; turnaround time: immediate). **Context** Basic reproduction number implies baseline infection control measures in place. Symptom-based screening (individuals in symptomatic stage of the disease are detected and isolated). Isolated individuals are assumed to have a reduced transmission probability. Model assumes a 'lockdown' scenario in the general population (contact reduction within the population).	**Measure vs no measure** Comparison of the outcome in scenarios with the measure in its most conservative form of implementation (testing every 2 days) with a scenario without the measure.	**5. Number of deaths** **Cumulative number of deaths among residents after 550 days** ***Direction of effect favours the measure (▲)*** The cumulative number of deaths among residents was higher in the scenario without the measure (1410 deaths/100,000 residents) in comparison with the scenario with the most conservative form of surveillance testing with antigen-based tests (testing every 2 days) (1181 deaths/100,000 residents). (Data extracted from plots.)
		5. Number of deaths **Cumulative number of deaths among staff after 550 days** ***Direction of effect favours the measure (▲)*** The cumulative number of deaths among staff was higher in the scenario without the measure (135 deaths/100,000 staff) in comparison with the scenario with the most conservative form of surveillance testing with antigen-based tests (testing every 2 days) (88 deaths/100,000 staff). (Data extracted from plots.)
Routine testing of residents and staff independent of symptom status Serial testing in the form of conducting PCR-based tests (peak sensitivity: 80%; turnaround time: 48 h) on 100% of staff at different rates **Context** Basic reproduction number implies base-	**Higher vs lower rates of testing** Comparison of the outcome in a scenario with the measure at the highest rate of testing (daily) in comparison with the scenario with the measure at its lowest rate (every 14 days)	**5. Number of deaths** **Cumulative number of deaths among residents after 550 days** ***Direction of effect favours higher rates of testing*** The cumulative number of deaths among residents was lower in the scenario with testing every day (760 deaths/100,000 residents) in comparison with the scenario with testing every 14 days (1180 deaths/100,000 residents). The scenarios with the testing rates in between showed an effect in the same direction with a dose-response effect: testing every 7 days: 1050/100,000; testing every 5 days: 990/100,000; and testing every 2 days: 830/100,000. (Data extracted from plots.)
		5. Number of deaths

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line infection control measures in place. Symptom-based screening (individuals in symptomatic stage of the disease are detected and isolated). Isolated individuals are assumed to have a reduced transmission probability. Model assumes a 'lockdown' scenario in the general population (contact reduction within the population).		**Cumulative number of deaths among staff after 550 days** ***Direction of effect favours higher rates of testing*** The cumulative number of deaths among staff was lower in the scenario with testing every day (90 deaths/100,000 staff) in comparison with the scenario with testing every 14 days (120 deaths/100,000 staff). The scenarios with the testing rates in between showed an effect in the same direction with a dose-response effect: testing every 7 days: 110/100,000, testing every 5 days: 105/100,000, and testing every 2 days: 95/100,000. (Data extracted from plots.)
Routine testing of residents and staff independent of symptom status Serial testing in the form of conducting antigen-based tests (peak sensitivity: 85%; turnaround time: immediate) on 100% of staff at different rates **Context** Basic reproduction number implies baseline infection control measures in place. Symptom-based screening (individuals in symptomatic stage of the disease are detected and isolated). Isolated individuals are assumed to have a reduced transmission probability. Model assumes a 'lockdown' scenario in the general population (contact reduction within the population).	**Higher vs lower rates of testing** Comparison of the outcome in a scenario with the measure at the highest rate of testing (daily) in comparison with the scenario with the measure at its lowest rate (every 2 days)	**5. Number of deaths** **Cumulative number of deaths among residents after 550 days** ***Direction of effect favours higher rates of testing*** The cumulative number of deaths among residents was lower in the scenario with testing every day (685 deaths/100,000 residents) in comparison with the scenario with testing every 2 days (715 deaths/100,000 residents). (Data extracted from plots.)
		5. Number of deaths **Cumulative number of deaths among staff after 550 days** ***Direction of effect favours higher rates of testing*** The cumulative number of deaths among staff was lower in the scenario with testing every day (86 deaths/100,000 staff), in comparison with the scenario with testing every 2 days) (88 deaths/100,000 staff). (Data extracted from plots.)
Routine testing of residents and staff independent of symptom status Serial testing in the form of conducting PCR-based tests on 100% of staff every 7 days (peak sensitivity: 80%)	**Higher vs lower turnaround times** Comparison of the outcome in a scenario with the measure at the lowest turnaround time between conducting the test and availability of results (12 h) in comparison with the sce-	**5. Number of deaths** **Cumulative number of deaths among residents after 550 days** ***Direction of effect favours lower turnaround times*** The cumulative number of deaths among residents was lower in the scenario with a turnaround time of 12 h (910 deaths/100,000 residents), in comparison with the scenario with a turnaround time of 96 h (1055 deaths/100,000 residents). The scenarios with turnaround times in between showed an effect in the same direction with a dose-response effect: testing with a turnaround time of 24

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Context Basic reproduction number implies baseline infection control measures in place. Symptom-based screening (individuals in symptomatic stage of the disease are detected and isolated). Isolated individuals are assumed to have a reduced transmission probability. Model assumes a 'lockdown' scenario in the general population (contact reduction within the population).	nario with the highest turnaround time (96 h).	h: 935/100,000; with turnaround time of 48 h: 985/100,000; and with a turnaround time of 72 h: 1030/100,000. (Data extracted from plots.) **5. Number of deaths** **Cumulative number of deaths among staff after 550 days** ***Direction of effect favours lower turnaround times*** The cumulative number of deaths among residents was lower in the scenario with a turnaround time of 12 h (102 deaths/100,000 staff) in comparison with the scenario with a turnaround time of 96 h (112 deaths/100,000 staff). The scenarios with turnaround times in between showed an effect in the same direction with a dose-response effect: testing with a turnaround time of 24 h: 104/100,000; with turnaround time of 48 h: 108/100,000; and with a turnaround time of 72 h: 110/100,000. (Data extracted from plots.)
Routine testing of residents and staff independent of symptom status Serial testing in the form of conducting PCR-based tests on 100% of staff every 7 days (turnaround time: 48 h) **Context** Basic reproduction number implies baseline infection control measures in place. Symptom-based screening (individuals in symptomatic stage of the disease are detected and isolated). Isolated individuals are assumed to have a reduced transmission probability. Model assumes a 'lockdown' scenario in the general population (contact reduction within the population).	**Higher vs lower test sensitivity** Comparison of the outcome in a scenario with the highest sensitivity (30% in prodromal phase (PdP); 75% in presymptomatic phase (PsP), 95% in symptomatic infectious phase (SIP)) in comparison with the scenario with the lowest sensitivity (0% in PdP; 10% in PsP; 65% in SIP).	**5. Number of deaths** **Cumulative number of deaths among residents after 550 days** ***Direction of effect favours higher test sensitivity*** The cumulative number of deaths among residents was lower in the scenario with a higher test sensitivity (30% in PdP; 75% in PsP, 95% in SIP; 915 deaths/100,000 residents) in comparison with the scenario with the lowest sensitivity (0% in PdP; 10% in PsP, 65% in SIP; 1125 deaths/100,000 residents). The scenarios with test sensitivities in between showed an effect in the same direction with a dose-response effect: testing with test with very good sensitivity (25% in PdP; 75% in PsP, 90% in SIP) 945/100,000; with a good sensitivity (15% in PdP; 60% in PsP, 80% in SIP) 985/100,000; and with an intermediate sensitivity (3% in PdP; 30% in PsP, 75% in SIP) 1055/100,000. (Data extracted from plots.) **5. Number of deaths** **Cumulative number of deaths among staff after 550 days** ***Direction of effect favours higher test sensitivity (▲)*** The cumulative number of deaths among staff was lower in the scenario with a higher test sensitivity (30% in PdP; 75% in PsP, 95% in SIP; 102 deaths/100,000 staff) in comparison with the scenario with the lowest sensitivity (0% in PdP; 10% in PsP, 65% in SIP; 116 deaths/100,000 staff). The scenarios with test sensitivities in between showed an effect in the same direction with a dose-response effect: testing with test with very good sensitivity (25% in PdP; 75% in PsP, 90% in SIP) 104/100,000; with a good sensitivity (15% in PdP; 60% in PsP, 80% in SIP) 107/100,000; and with an intermediate sensitivity (3% in PdP; 30% in PsP, 75% in SIP) 116/100,000. (Data extracted from plots.)
Routine testing of residents and staff independent of symptom status	**PCR-based vs antigen-based testing** Comparison of the outcome in scenarios with PCR-based testing	**5. Number of deaths** **Cumulative number of deaths among residents after 550 days** ***Direction of effect favours antigen-based testing*** The cumulative number of deaths among residents was higher in the scenario of daily testing with PCR-based tests (760 deaths/100,000 residents) in

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Serial testing in the form of conducting PCR-based tests (turnaround time: 48 h; peak sensitivity: 80%) or antigen-based tests (turnaround time: immediate; peak sensitivity: 85%) on 100% of staff every day and every 2 days **Context** Basic reproduction number implies baseline infection control measures in place. Symptom-based screening (individuals in symptomatic stage of the disease are detected and isolated). Isolated individuals are assumed to have a reduced transmission probability. Model assumes a 'lockdown' scenario in the general population (contact reduction within the population).	(turnaround time: 48 h; peak sensitivity: 80%) and antigen-based testing (turnaround time: immediate; peak sensitivity: 85%) at the same rate	comparison with the scenario of daily testing with antigen-based tests (685 deaths/100,000 residents). The cumulative number of deaths among residents was higher in the scenario of testing every 2 days with PCR-based tests (835 deaths/100,000 residents) in comparison with the scenario of testing every 2 days with antigen-based tests (715 deaths/100,000 residents). (Data extracted from plots.) **5. Number of deaths** **Cumulative number of deaths among staff after 550 days** ***Direction of effect favours antigen-based testing*** The cumulative number of deaths among staff was higher in the scenario of daily testing with PCR-based tests (92 deaths/100,000 staff) in comparison with the scenario of daily testing with antigen-based tests (86 deaths/100,000 staff). The cumulative number of deaths among staff was higher in the scenario of testing every 2 days with PCR-based tests (97 deaths/100,000 staff) in comparison with the scenario of testing every 2 days with antigen-based tests (88 deaths/100,000 staff). (Data extracted from plots.)

Vilches 2020

Routine testing of residents and staff independent of symptom status Serial testing in the form of conducting PCR-based tests on 100% of staff every 7 days (peak sensitivity: 91%; turnaround time: 48 h; scenario with the most conservative test characteristics) **Context** Basic reproduction number implies baseline infection control measures in place. Symptom-based screening (individuals in symptomatic stage of the disease are detected and isolated). Isolated individuals are assumed to have reduced	**Measure vs no measure** Comparison of the outcome in scenarios with measure in its most conservative form of implementation (testing every 7 days, peak sensitivity: 91%, turnaround time: 48 h) with a scenario without the measure	**1. Number of infections** **Mean relative reduction in infections among residents over 200 days** ***Direction of effect favours the measure (▲)*** The baseline scenario showed an attack rate among residents of 24.9% (95% CrI 24.4% to 25.4%). The testing scenario with the most conservative assumptions about the tests characteristics showed a relative reduction in infections among residents of 25.9% (95% CrI 23.3% to 28.3%). All other scenarios with less conservative assumptions about the test characteristics showed an effect in the same direction with a dose-response effect: the mean relative reduction of infections through testing every 7 days with a test of lower sensitivity (peak sensitivity: 91%) and turnaround time of 24 h was 34.3% (32.2% to 36.2%); 30.3% (28.4% to 32.3%) with a test of higher sensitivity (peak sensitivity 96%) and turnaround time of 48 h; and 42.1% (40.3% to 43.9%) with a test of higher sensitivity (peak sensitivity: 96%) and turnaround time of 24 h. **1. Number of infections** **Mean relative reduction in infections among staff over 200 days** ***Direction of effect favours the measure (▲)*** The baseline scenario showed an attack rate among staff of 10.6% (95% CrI 10.3%-10.8%). The testing scenario with the most conservative assumptions about the tests characteristics showed a relative reduction in infections among staff of 25.3% (95% CrI 22.6% to 28.1%).

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transmission probability. Model assumes a 'lockdown' scenario in the general population (contact reduction within the population).

All other scenarios with less conservative assumptions about the test characteristics showed an effect in the same direction with a dose-response effect: the mean relative reduction of infections through testing every 7 days with a test of lower sensitivity (peak sensitivity: 91%) and turnaround time of 24 h was 33.4% (31.0% to 35.5%); 29.5% (27.2% to 31.7%) with a test of higher sensitivity (peak sensitivity: 96%) and turnaround time of 48 h; and 41.5% (39.3% to 43.8%) with a test of higher sensitivity (peak sensitivity: 96%) and turnaround time of 24 h.

4. Number of hospitalisations

Mean relative reduction in hospitalisations among residents over 200 days
Direction of effect favours the measure (▲)
The baseline scenario showed a hospitalisation rate among residents of 21.1 (95% CrI 20.6% to 21.8%) per 1000 residents. The testing scenario with the most conservative assumptions about the test's characteristics showed a relative reduction in infections among residents of 23.9% (95% CrI 20.4% to 27.1%).
All other scenarios with less conservative assumptions about the test characteristics showed an effect in the same direction with a dose-response effect: the mean relative reduction of infections through testing every 7 days with a test of lower sensitivity (peak sensitivity: 91%) and turnaround time of 24 h was 34.4% (31.1% to 37.1%); 29.9% (26.6% to 33.0%) with a test of higher sensitivity (peak sensitivity: 96%) and turnaround time of 48 h; and 42.4% (39.7% to 45.2%) with a test of higher sensitivity (peak sensitivity: 96%) and turnaround time of 24 h

4. Number of hospitalisations

Mean relative reduction in hospitalisations among staff over 200 days
Direction of effect favours the measure (▲)
The baseline scenario showed a hospitalisation rate among staff of 2.8 (95% CrI 2.6 to 3.0) per 1000 staff. The testing scenario with the most conservative assumptions about the test's characteristics showed a relative reduction in infections among staff of 26.2% (95% CrI 16.9% to 33.8%).
All other scenarios with less conservative assumptions about the test characteristics showed an effect in the same direction with a dose-response effect: the mean relative reduction of infections through testing every 7 days with a test of lower sensitivity (peak sensitivity: 91%) and turnaround time of 24 h was 28.4% (23.0% to 36.8%); 25.3% (17.2% to 31.9%) with a test of higher sensitivity (peak sensitivity: 96%) and turnaround time of 48 h; and 38.6% (31.9% to 45.0%) with a test of higher sensitivity (peak sensitivity: 96%) and turnaround time of 24 h.

5. Number of deaths

Mean relative reduction in deaths among residents over 200 days
Direction of effect favours the measure (▲).
The baseline scenario showed a mortality rate of 52.2 (95% CrI 51.0 to 53.4) per 1000 residents. The testing scenario with the most conservative assumptions about the test's characteristics showed a relative reduction in infections among residents of 26.1% (95% CrI 23.5% to 28.6%).
All other scenarios with less conservative assumptions about the test characteristics showed an effect in the same direction with a dose-response effect: the mean relative reduction of infections through testing every 7 days with a test of lower sensitivity (peak sensitivity: 91%) and turnaround time of 24 h was 34.6% (32.4% to 36.9%); 31.0% (28.9% to 33.2%) with a test of higher sensitivity (peak sensitivity: 96%) and turnaround time of 48 h; and 43.2% (41.3% to 45.4%) with a test of higher sensitivity (peak sensitivity: 96%) and turnaround time of 24 h.

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		5. Number of deaths **Mean relative reduction in deaths among staff over 200 days** ***Direction of effect favours the measure (▲)*** The baseline scenario showed a mortality rate of 0.35 (95% CrI 0.28 to 0.43) per 1000 staff. The testing scenario with the most conservative assumptions about the test's characteristics showed a relative reduction in infections among staff by 20.5% (95% CrI −0.04% to 37.7%). All other scenarios with less conservative assumptions about the test characteristics showed an effect in the same direction with a dose-response effect: the mean relative reduction of infections through testing every 7 days with a test of lower sensitivity (peak sensitivity: 91%) and turnaround time of 24 h was 28.8% (0.01% to 46.4%); 24.4% (0.01% to 43.3%) with a test of higher sensitivity (peak sensitivity: 96%) and turnaround time of 48 h; and 45.4% (24.4% to 59.9%) with a test of higher sensitivity (peak sensitivity: 96%) and turnaround time of 24 h.
Routine testing of residents and staff independent of symptom status Serial testing in the form of conducting PCR-based tests on 100% of staff every 7 days **Context** Basic reproduction number implies baseline infection control measures in place. Symptom-based screening (individuals in symptomatic stage of the disease are detected and isolated). Isolated individuals are assumed to have reduced transmission probability. Model assumes a 'lockdown' scenario in the general population (contact reduction within the population).	**Higher vs lower turnaround time** Comparison of the outcome in scenarios with lower turnaround times (24 h) in comparison with the scenarios with higher turnaround times (48 h) at the same sensitivity at rate of testing	**1. Number of infections** **Mean relative reduction in infections among residents over 200 days** ***Direction of effect favours lower turnaround times*** The baseline scenario showed an attack rate among residents of 24.9% (95% CrI 24.4% to 25.4%). In the scenarios in which staff were tested every 7 days with a test of higher sensitivity, the scenarios with lower turnaround time (24 h) showed a higher mean relative reduction in infections of residents (42.1%, CrI 40.3% to 43.9%) in comparison with the scenarios with higher turnaround time (48 h; 30.3%, 95% CrI 28.4% to 32.3%). The scenarios with assumptions of a higher test sensitivity showed effects in the same direction, with a reduction of 34.3% (95% CrI 32.2% to 36.2%) for a turnaround time of 24 h and of 25.9% (95% CrI 23.3% to 28.3%) for a turnaround time of 48 h.
		1. Number of infections **Mean relative reduction in infections among staff over 200 days** ***Direction of effect favours lower turnaround times*** The baseline scenario showed an attack rate among staff of 10.6% (95% CrI 10.3% to 10.8%). In the scenarios in which staff were tested every 7 days with a test of higher test sensitivity, the scenarios with lower turnaround time (24 h) showed a higher mean relative reduction in infections of residents (41.5%; 95% CrI 39.3% to 43.8%) in comparison with the scenarios with higher turnaround time (48 h; 29.5%, 95% CrI 27.2% to 31.7%). The scenarios with assumptions of a higher test sensitivity showed effects in the same direction, with a reduction of 33.4% (95% CrI 31.0% to 35.5%) for a turnaround time of 24 h and of 25.3% (95% CrI 22.6% to 28.1%) for a turnaround time of 48 h.
		4. Number of hospitalisations **Mean relative reduction in hospitalisations among residents over 200 days** ***Direction of effect favours lower turnaround times*** The baseline scenario showed a hospitalisation rate among residents of 21.1, 95% CrI 20.6% to 21.8%) per 1000 residents. In the scenarios in which staff were tested every 7 days with a test of higher sensitivity, the scenarios with lower turnaround time (24 h) showed a higher mean relative reduction in hospitalisations of residents (42.4%, 95% CrI 39.7% to 45.2%) in comparison with the scenarios with higher turnaround time (48 h; 29.9%, 95% CrI 26.6% to 33.0%). The scenarios with assumptions of a higher test sensitivity showed ef-

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		fects in the same direction, with a reduction of 34.4% (95% CrI 31.1% to 37.1%) for a turnaround time of 24 h and of 23.9% (95% CrI 20.4% to 27.1%) for a turnaround time of 48 h. **4. Number of hospitalisations** **Mean relative reduction in hospitalisations among staff over 200 days** ***Direction of effect favours lower turnaround times*** The baseline scenario showed a hospitalisation rate among staff of 2.8, 95% CrI 2.6 to 3.0) per 1000 staff. In the scenarios in which staff were tested every 7 days with a test of higher sensitivity, the scenarios with lower turnaround time (24 h) showed a higher mean relative reduction in infections of residents (38.6%, 95% CrI 31.9% to 45.0%) in comparison with the scenarios with higher turnaround time (48 h; 25.3%, 95% CrI 17.2% to 31.9%). The scenarios with assumptions of a higher test sensitivity showed effects in the same direction, with a reduction of 28.4% (95% CrI 23.0% to 36.8%) for a turnaround time of 24 h and of 26.2%, 95% CrI 16.9% to 33.8%) for a turnaround time of 48 h. **5. Number of deaths** **Mean relative reduction in deaths among residents over 200 days** ***Direction of effect favours lower turnaround times*** The baseline scenario showed a mortality rate of 52.2 (95% CrI 51.0 to 53.4) per 1000 residents. In the scenarios in which staff were tested every 7 days with a test of higher sensitivity, the scenarios with lower turnaround time (24 h) showed a higher mean relative reduction in infections of residents (43.2%, 95% CrI 41.3% to 45.4%) in comparison with the scenarios with higher turnaround time (48 h; 31.0%, 95 % CrI 28.9% to 33.2%). The scenarios with assumptions of a higher test sensitivity showed effects in the same direction, with a reduction of 34.6% (95% CrI 32.4% to 36.9%) for a turnaround time of 24 h and of 26.1% (95% CrI 23.5% to 28.6%) for a turnaround time of 48 h.
		5. Number of deaths **Mean relative reduction in hospitalisations among staff over 200 days** ***Direction of effect favours lower turnaround times*** The baseline scenario showed mortality rate of 0.35 (95% CrI 0.28 to 0.43) per 1000 staff. In the scenarios in which staff were tested every 7 days with a test of higher sensitivity the scenarios with lower turnaround time (24 h) showed a higher mean relative reduction in deaths of staff (45.4%, 95% CrI 24.4% to 59.9%) in comparison with the scenarios with higher turnaround time (48 h; 24.4%, 95% CrI 0.01% to 43.3%). The scenarios with assumptions of a higher test sensitivity showed effects in the same direction, with a reduction of 28.8% (95% CrI 0.1% to 46.4%) for a turnaround time of 24 h and of 20.5% (95% CrI to 0.04% to 37.7%) for a turnaround time of 48 h.
Routine testing of residents and staff independent of symptom status Serial testing in the form of conducting PCR-based tests on 100% of staff every 7 days **Context**	**Higher vs lower test sensitivity** Comparison of the outcome in scenarios with higher test sensitivity in comparison with the scenarios with lower sensitivity at the same turnaround time and rate of testing.	**1. Number of infections** **Mean relative reduction in infections among residents over 200 days** ***Direction of effect favours higher test sensitivity*** The baseline scenario showed an attack rate among residents of 24.9% (95% CrI 24.4% to 25.4%). The scenarios in which staff were tested every 7 days with a test of higher sensitivity showed a higher mean relative reduction in infections of residents (turnaround time 24 h: 42.1%, 95% CrI 40.3% to 43.9%; turnaround time 48 h: 30.3%, 95% CrI 28.4% to 32.3%) in comparison with the scenarios with lower test sensitivity (turnaround time 24 h: 34.3% (95% CrI 32.2% to 36.2%); turnaround time 48 h: 25.9%, 95% CrI 23.3% to 28.3%).

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Basic reproduction number implies baseline infection control measures in place. Symptom-based screening (individuals in symptomatic stage of the disease are detected and isolated). Isolated individuals are assumed to have reduced transmission probability. Model assumes a 'lockdown' scenario in the general population (contact reduction within the population).

1. Number of infections

Mean relative reduction in infections among staff over 200 days
Direction of effect favours higher test sensitivity

The baseline scenario showed an attack rate among staff of 10.6% (95% CrI 10.3% to 10.8%). The scenarios in which staff were tested every 7 days with a test of higher sensitivity showed a higher mean relative reduction in infections of staff (turnaround time 24 h: 41.5%, 95% CrI 39.3% to 43.8%; turnaround time 48 h: 29.5%, 95% CrI 27.2% to 31.7%) in comparison with the scenarios with lower test sensitivity (turnaround time 24 h: 33.4%, 95% CrI 31.0% to 35.5%; turnaround time 48 h: 25.3%, 95% CrI 22.6% to 28.1%).

4. Number of hospitalisations

Mean relative reduction in hospitalisations among residents over 200 days
Direction of effect favours higher test sensitivity
The baseline scenario showed a hospitalisation rate among residents of 21.1 (95% CrI 20.6 to 21.8) per 1000 residents. The scenarios in which staff were tested every 7 days with a test of higher sensitivity showed a higher mean relative reduction in hospitalisations of residents (turnaround time 24 h: 42.4%, 95% CrI 39.7% to 45.2%; turnaround time 48 h: 29.9%, 95% CrI 26.6% to 33.0%) in comparison with the scenarios with lower test sensitivity (turnaround time 34.4%, 95% 31.1% to 37.1%; turnaround time 48 h: 23.9%, 95% CrI 20.4% to 27.1%).

4. Number of hospitalisations

Mean relative reduction in hospitalisations among staff over 200 days
Direction of effect favours higher test sensitivity
The baseline scenario showed a hospitalisation rate among staff of 2.8 (95% CrI 2.6 to 3.0) per 1000 staff. The scenarios in which staff were tested every 7 days with a test of higher sensitivity showed a higher mean relative reduction in hospitalisations of staff (turnaround time 24 h: 38.6%, 95% CrI 31.9% to 45.0%; turnaround time 48 h: 25.3%, 95% CrI 17.2% to 31.9%) in comparison with the scenarios with lower test sensitivity (turnaround time 28.4%, 95% CrI 23.0% to 36.8%; turnaround time 48 h: 26.2%, 95% CrI 16.9% to 33.8%).

5. Number of deaths

Mean relative reduction in deaths among residents over 200 days
Direction of effect favours higher test sensitivity
The baseline scenario showed a mortality rate of 52.2 (95% CrI 51.0 to 53.4) per 1000 residents. The scenarios in which staff were tested every 7 days with a test of higher sensitivity showed a higher mean relative reduction in deaths of residents (turnaround time 24 h: 43.2%, 95% CrI 41.3 to 45.4%; turnaround time 48 h: 31.0%, 95% CrI 28.9% to 33.2%) in comparison with the scenarios with lower test sensitivity (turnaround time 34.6%, 95% CrI 32.4% to 36.9%; turnaround time 48 h: 26.1%, 95% CrI 23.5% to 28.6%).

5. Number of deaths

Mean relative reduction in deaths among staff over 200 days
Direction of effect favours lower turnaround times
The baseline scenario showed a mortality rate of 0.35 (95% CrI 0.28 to 0.43) per 1000 staff. The scenarios in which staff were tested every 7 days with a test of higher sensitivity showed a higher mean relative reduction in deaths of staff (turnaround time 24 h: 45.4%, 95% CrI 24.4% to 59.9%; turnaround time 48 h: 24.4%, 95% CrI 0.01% to 43.3%) in comparison with the scenarios with lower

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	test sensitivity (turnaround time 28.8%, 95% CrI 0.1% to 46.4%; turnaround time 48 h: 20.5%, 95% CrI to 0.04% to 37.7%).

CI: confidence interval; **CrI:** credibility interval; **IQR:** interquartile range; **LTCFs:** long-term care facilities; **PdP:** prodromal phase; **POC:** point-of-care; **PPE:** personal protective equipment; **PsP:** presymptomatic phase; **R0:** reproduction rate; **RT-PCR:** reverse transcription polymerase chain reaction; **SD:** standard deviation; **SIP:** symptomatic infectious phase

Appendix 13. Outbreak control measures: study-by-study results summaries

Intervention category: short description	Comparison: short description and context	Outcome category: description and overview of direction
Holmdahl 2021		
Immunity-based staffing Staff who were infected and have recovered are prioritised to be placed in the non-COVID-19 cohort, while staff who are still susceptible are placed in the COVID-19 cohort (with adequate PPE provided) **Context** Infected residents are placed in a COVID-19 unit. Staff in the COVID-19 unit are assumed to properly use PPE, reducing the probability of infection. The mean probability of transmission upon contact implies that baseline transmission control measures are in place. Residents have reduced contact with residents outside their shared rooms.	**Immunity-based staffing vs no immunity-based staffing** Comparison of the outcome across 100 iterations of the modelled scenario with prioritised placement of immune staff members in the non-COVID-19 unit in comparison with the iterations of the scenario without prioritised placement of staff	**1. Number of infections** **Mean cumulative incidence among residents over 3 months** ***Direction of effect favours immunity-based staffing (▲)*** Immunity-based staffing showed a lower mean cumulative number of infections among residents across 100 iterations of the scenario with the measure (mean: 21%; SD: 5%) in comparison with the scenario of no prioritised placement of staff (mean: 26%; SD: 6%) after 3 months of follow-up. **1. Number of infections** **Mean cumulative incidence among staff over 3 months** ***Direction of effect favours immunity-based staffing (▲)*** Immunity-based staffing showed a lower mean cumulative number of infections among staff across 100 iterations of the scenario with the measure (mean: 45%; SD: 5%) in comparison with the scenario of no prioritised placement of staff (mean: 50%; SD: 6%) after 3 months of follow up.
Lipsitz 2020		
Separating infected and non-infected Implementation and adherence of separating residents who are confirmed by testing to be infected with COVID-19 or who are recovering from COVID-19 from residents who are not infected and have unknown	**Measure vs no measure** Comparison of the outcome in LTCFs with implementation of a mask and PPE use order and those LTCFs without such an order based on weekly data from 123 LTCFs Analysis did adjust for one other measure — cohort-	**1. Number of infections** **Mean weekly infections rates** ***Direction of effect favours the measure* (▲)** Separating infected and non-infected showed a decrease in mean weekly infection rates (β coefficient: −0.50; 95% CI −0.84 to −0.16) within LTCFs with measure implementation compared with LTCFs without implementation. **1. Number of infections** **Odds of having a weekly infection rate of zero infections**

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status (i. e. in dedicated wings/units or in separate rooms) **Context** Measure was implemented as part of a large multicomponent measure intended to increase the implementation and adherence of infection control measures in LTCFs	ing of residents — and for infection rate in the community.	***Direction of effect favours the measure (▲)*** Separating infected and non-infected showed increased odds of zero infections within LTCFs with measure implementation compared to LTCFS without measure implementation (aOR 3.00, 95% CI 1.34 to 6.71) **5. Number of deaths** **Mean weekly mortality rate** ***Direction of effect favours the measure (▲)*** Separating infected and non-infected showed a decrease in mean weekly mortality rates (β coefficient: −0.38, 95% CI −0.75 to 0.00) within LTCFs with measure implementation compared with LTCFs without implementation. **5. Number of deaths** **Odds of having a weekly mortality rate of zero infections** ***Direction of effect favours the measure (▲)*** Separating infected and non-infected showed increased odds of zero deaths within LTCFs with measure implementation compared to LTCFs without measure implementation (aOR 1.98, 95% CI 0.58 to 6.75)

Lombardo 2021

Isolation of cases Implementation and adherence to isolation of residents with a positive SARS-CoV-2 test. The study assesses difficulties with the isolation, which we assume to be a proxy for less stringent implementation of the isolation measure. **Context** Likely additional infection control measures in place in intervention and control group, not further specified in study	**More vs less stringent implementation** Comparison of LTCFs with and without inability to isolate. Therefore, a more or less fully implemented measure. The comparison is established through a multivariate logistic regression model with survey data of in total 1356 LTCFs. Analysis did adjust for one other measure — cohorting of residents — and for infection rate in the community.	**3. Outbreaks in LTCFs** **Probability of outbreaks** ***Direction of effect favours the measure (▲)*** Facilities with difficulties isolating residents were positively associated with a COVID-19 outbreak (aOR 1.97, 95% CI 1.42 to 2.73)

See 2020

Generalised outbreak response testing PCR-based testing of 100% of staff independent of symptoms triggered by an outbreak in the facility at different rates of testing (every 7 days and every 3 days; peak sensitivity: 95%; turnaround time 24 h or 48 h) **Context** Reproduction value of the infection in the LTCF in an outbreak scenario is assumed to be	**Measure vs no measure** Comparison of outcomes in the scenario with the most conservative version of testing (testing every 7 days; peak sensitivity: 95%; turnaround time 48 h) in comparison with a scenario without the measure	**Number of infections** **Mean number of cases per outbreak** ***Direction of effect favours testing (▲)*** The most conservative version of the measure of surveillance testing (testing every 7 days; peak sensitivity: 95%; turnaround time 48 h) showed a reduction in the mean number of cases in outbreaks by 54.1% across the iterations of the scenario with the measure in comparison with the baseline scenario without testing showed a mean number of 50 cases per outbreak.
	Higher vs lower rates of testing Comparison of outcomes across iterations of scenarios with the highest rate of PCR-based testing (testing every 3 days) in	**Number of infections** **Mean number of cases per outbreak** ***Direction of effect favours higher rates of testing (▲)*** The scenarios of surveillance testing with the highest rates of PCR-based testing of staff (testing every 3 days) showed a higher proportion of cases prevented through the measure in comparison with the baseline scenario across the iterations of the model than the scenarios of testing at the

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1.4, which implies that strong baseline infection control measures are in place. Symptomatic residents and staff are tested and isolated.	comparison with the scenario of the lowest rate of testing (every 7 days) with all other test characteristics being equal	lowest rate (weekly testing) for both a turnaround time of 48 h (−79.3% vs −54.1%) and of 24 h (−87.3% vs −67.8%). The baseline scenario without testing showed a mean number of 50 cases per outbreak.
	Higher vs lower turnaround time Comparison of outcomes across iterations of scenarios with the lowest turnaround time (24 h) in comparison with the scenarios with the highest turnaround time (48 h) with all other test characteristics being equal	**Number of infections** **Mean number of cases per outbreak** ***Direction of effect favours lower turnaround times of PCR-tests (▲)*** The scenarios of surveillance testing with the lowest turnaround time rates of PCR-based testing of staff (24 h) showed a higher proportion of cases prevented through the measure in comparison with the baseline scenario across the iterations of the model than the scenarios of testing with a higher turnaround time (48 h) for both a rate of weekly testing (−67.8% vs −54.1%) and for testing every 3 days (−87.3% vs −92.8%). The baseline scenario without testing showed a mean number of 50 cases per outbreak.
Generalised outbreak response testing Antigen-based testing of 100% of staff independent of symptoms triggered by an outbreak in the facility at different rates of testing (every 7 days, every 3 days, or every day; peak sensitivity: 81% or 48%; turnaround time: immediate) **Context** Reproduction value of the infection in the LTCF in an outbreak scenario is assumed to be 1.4, which implies that strong baseline infection control measures are in place. Symptomatic residents and staff are tested and isolated.	**Higher vs lower rates of testing** Comparison of outcomes across iterations of the model with the highest rate of antigen-based testing (testing every day) in comparison with the scenario of lower rates of testing (every 3 days and every 7 days) with all other test characteristics being equal	**Number of infections** **Mean number of cases per outbreak** ***Direction of effect favours higher rates of testing (▲)*** The scenarios of surveillance testing with the highest rates of antigen-based testing at a test sensitivity of 48% of staff (testing every 3 days) showed a higher proportion of cases prevented through the measure in comparison with the baseline scenario across the iterations of the model than the scenarios of testing at the lower rates of testing (every 3 days) for both a test sensitivity of 48% (−79.7% vs −50.9%) and of 81% (−89.7% vs −72.9%). The scenario of antigen-based testing daily (test sensitivity: 48%) showed an effect in the same direction with a dose-response effect (−92.4%). The baseline scenario without testing showed a mean number of 50 cases per outbreak.
	Higher vs lower sensitivity of testing Comparison of outcomes across iterations of the model with the highest sensitivity of antigen-based tests (81%) in comparison with the scenario of lower rates of testing (48%) with all other test characteristics being equal	**Number of infections** **Mean number of cases per outbreak** ***Direction of effect favours lower turnaround times of PCR tests (▲)*** Surveillance testing of staff with antigen-based tests with the highest sensitivity of (81%) showed a higher proportion of cases prevented through the measure in comparison with the baseline scenario across the iterations of the model than the scenarios with lower test sensitivity (48%) for both a rate of weekly testing (−72.9% vs −50.9%) and for testing every 3 days (−89.7% vs −79.7 %). The baseline scenario without testing showed a mean number of 50 cases per outbreak.
Generalised outbreak response testing **P**CR-based or antigen-based testing of 100% of staff independent of symptoms triggered by an outbreak in the facility at different rates of testing (every 7 days, every 3 days, or every day; peak sensitivity: 95%, 81% or 48%;	**PCR- vs antigen-based testing** Comparison of the outcome across iterations of scenarios of PCR-based serial testing (sensitivity: 95%, turnaround time: 24 h/48 h) in comparison with an antigen-based test (sensitivity: 48% and 81%; turnaround time: immediate).	**Number of infections** **Mean number of cases per outbreak** ***The comparison of PCR-based testing and antigen-based testing showed mixed effects (•)*** The scenarios of surveillance testing of staff with PCR-based tests showed mixed results regarding the outcome of cases per outbreak prevented through the measure in comparison with the scenarios of antigen-based testing. For weekly testing, PCR-based testing with a turnaround time of 48 h led to a reduction of 54.1% and with a turnaround time of 24 h a reduction of 67.8%, while antigen-based testing with a sensitivity of 81% showed a reduction of 72.9% and for a sensitivity of 48% a reduction of 50.9%. For testing every 3 days, PCR-based testing with a turnaround time of 48 h led to a reduction of 79.3% and with a turnaround time of 24 h a reduction

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turnaround time: 48 h, 24 h, and immediate) **Context** Reproduction value of the infection in the LTCF in an outbreak scenario is assumed to be 1.4, which implies that strong baseline infection control measures are in place. Symptomatic residents and staff are tested and isolated.		of 87.3%, while antigen-based testing with a sensitivity of 81% showed a reduction of 89.7% and for a sensitivity of 48% a reduction of 79.7%. The baseline scenario without testing showed a mean number of 50 cases per outbreak.
Shallcross 2021		
Isolation of cases Implementation and adherence to isolation of residents with a positive SARS-CoV-2 test. The study assesses difficulties with the isolation, which we assume to be a proxy for less stringent implementation of the isolation measure.	**More implementation vs less implementation** Comparison of LTCFs with (intervention group) and without inability to isolate (control group). The comparison is established through a multivariate logistic regression model with survey data of in total 5126 LTCFs. The analysis did adjust for other infection control measures implemented in the facility and several confounding factors.	**1. Number of infections** **Number and proportion of infections among residents** ***Direction of effect favours the measure (▲)*** In total, 5993 cases of confirmed SARS-CoV-2 were registered among 69,334 residents (8.6%) within the intervention group, and 7002 infections among 43,816 residents (16%) within the comparator group in the 3311 LTCFs included for this analysis. Isolation of cases shows lower odds of observing SARS-CoV-2 infections among residents in LTCFs in the intervention group (aOR 0.75, 95% CI 0.72 to 0.78)
		1. Number of infections **Number and proportion of infections among staff** ***Direction of effect favours the measure (▲)*** In total, 2999 cases of confirmed SARS-CoV-2 were registered among 98,839 members of staff (3%) within the intervention group, and 4052 infections among 64,992 members of staff (6.2%) within the comparator group in the 3138 LTCFs included for this analysis. Isolation of cases shows lower odds of observing SARS-CoV-2 infections among members of staff receiving the measure (aOR 0.68, 95% CI 0.64 to 0.71).
		1. Number of infections **Probability of large outbreaks** ***Direction of effect favours the measure (▲)*** In total, 128 of 1035 LTCFs (12.4%) reported a large outbreak within the intervention group (≥ 20 cases), and 182 of 846 LTCFs (21.5%) within the comparator group in the 1881 LTFs included for this analysis. Isolation of cases shows lower odds of a large outbreak in LTCFs in the intervention group (aOR 0.62, 95% CI 0.47 to 0.81).
		3. Outbreaks in LTCFs **Probability of outbreaks of any size** ***Direction of effect favours the measure (▲)*** In total, 1035 of 2052 LTCFs (50.4%) reported an outbreak within the intervention group, and 846 of 1077 LTCFs (78.6%) within the comparator group in the 3129 LTCFs used for this analysis. Isolation of cases shows lower odds of a large outbreak (≥ 1 cases) in LTCFs in the intervention group (aOR 0.54, 95% CI 0.43 to 0.68).
Separating infected and non-infected residents Implementation and adherence to assigning staff with either infected or	**Measure vs no measure** Comparison of outcomes in LTCFs reporting to "often or always" cohorting staff with either infected	**1. Number of infections** **Number and proportion of infections among residents** ***Direction of effect favours the measure (▲)*** In total, 3112 cases of confirmed SARS-CoV-2 were registered among 30,330 residents (10.3%) within the intervention group, and 4458 infec-

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uninfected residents. This was taken as a proxy for the separation of infected and non-infected individuals.	or uninfected residents (intervention group), in comparison with the outcomes in LTCFs reporting their frequency of cohorting staff as "not at all" (control group) The comparison is established through a multivariate logistic regression model with survey data of in total 5126 LTCFs. Analysis did adjust for other infection control measures implemented in the facility and several confounding factors	tions among 25,950 residents (17.2%) within the comparator group in the 3311 LTCFs included for this analysis. Separating infected and non-infected residents shows lower odds of observing SARS-CoV-2 infections among residents in LTCFs in the intervention group (aOR 0.77, 95% CI 0.73 to 0.81). **1. Number of infections** **Number and proportion of infections among staff** ***Direction of effect favours the measure (▲)*** In total, 1653 cases of confirmed SARS-CoV-2 were registered among 43,123 members of staff (3.8%) within the intervention group, and 2471 infections among 38,870 members of staff (6.4%) within the comparator group in the 3138 LTCFs included for this analysis. Separating infected and non-infected residents shows lower odds of observing SARS-CoV-2 infections among members of staff receiving the measure (aOR 0.83, 95% CI 0.78 to 0.88). **1. Number of infections** **Probability of large outbreaks** ***Direction of effect favours the comparator (▼)*** In total, 74 of 470 LTCFs (15.7%) reported a large outbreak within the intervention group (≥ 20 cases), and 104 of 580 LTCFs (17.9%) within the comparator group in the 1881 LTFs included for this analysis. Separating infected and non-infected residents shows higher odds of a large outbreak in LTCFs in the intervention group (aOR 1.02, 95% CI 0.72 to 1.45). **3. Outbreaks in LTCFs** **Probability of outbreaks of any size** ***Direction of effect favours the measure (▲)*** In total, 470 of 829 LTCFs (56.7%) reported an outbreak or — based on our process model — contamination (≥ 1 cases) within the intervention group, and 580 of 692 LTCFs (83.8%) within the comparator group in the 3129 LTCFs used for this analysis. Separating infected and non-infected residents shows lower odds of a large outbreak in LTCFs in the intervention group (aOR 0.38, 95% CI 0.29 to 0.52).

Telford 2021

Separating infected and non-infected residents Implementation and adherence to having a COVID-19 unit or observation area that is physically separated from COVID-19 negative residents **Context** LTCFs with higher and lower prevalence implemented different infection control measures in the facility.	**Measure vs no measure** Comparison of 13 LTCFs with a low prevalence of SARS-CoV-2 (≤ 39% infections with those facilities with a high prevalence of 11 SARS-CoV-2 (> 39% infections) on whether they had implemented the measure. The overall prevalence of SARS-CoV-2 in all 24 LTCFs was used as the cut-off value for the grouping. Analysis did not adjust for other infection control measures implemented in the facility.	**1. Number of infections** **Size of SARS-CoV-2 outbreak in LTCFs** ***Direction of effect favours the measure (▲)*** In total, 9 out of 11 LTCFs with a high-prevalence outbreak of SARS-CoV-2 (≥ 39% infection prevalence), and 11 out of 13 LTCFs with a low prevalence of SARS-CoV-2 (≤ 39% infection prevalence) did implement the measure. This results in reduced odds of having a high-prevalence outbreak in facilities with the measure in place (OR 0.82, 95% CI 0.10-7.02).
Separating infected and non-infected residents Implementation and adherence having droplet	**Measure vs no measure** Comparison of 13 LTCFs with a low prevalence of SARS-CoV-2 (≤ 39% infec-	**1. Number of infections** **Size of SARS-CoV-2 outbreak in LTCFs** ***Direction of effect favours the measure (▲)***

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and contact precaution signage which were posted outside COVID-19 unit and individual rooms of COVID-19-positive residents **Context** LTCFs with higher and lower prevalence implemented different infection control measures in the facility.	tions) with those facilities with a high prevalence of 11 SARS-CoV-2 (> 39% infections) on whether they had implemented the measure. The overall prevalence of SARS-CoV-2 in all 24 LTCFs was used as cut-off value for the grouping. Analysis did not adjust for other infection control measures implemented in the facility.	In total, 3 out of 11 LTCFs with a high-prevalence outbreak of SARS-CoV-2 (≥ 39% infection prevalence), and 10 out of 13 LTCFs with a low prevalence of SARS-CoV-2 (≤ 39% infection prevalence) did implement the measure. This results in reduced odds of having a high-prevalence outbreak in facilities with the measure in place (OR 0.11, 95% CI 0.02-0.72).
Separating infected and non-infected residents Implementation and adherence to separating staff into teams working with infected and non-infected **Context** LTCFs with higher and lower prevalence implemented different infection control measures in the facility.	**Measure vs no measure** Comparison of 13 LTCFs with a low prevalence of SARS-CoV-2 (≤ 39% infections) with those facilities with a high prevalence of 11 SARS-CoV-2 (> 39% infections) on whether they had implemented the measure. The overall prevalence of SARS-CoV-2 in all 24 LTCFs was used as cut-off value for the grouping. Analysis did not adjust for other infection control measures implemented in the facility.	**1. Number of infections** **Size of SARS-CoV-2 outbreak in LTCFs** ***Direction of effect favours the measure (▲)*** In total, 8 out of 11 LTCFs with a high-prevalence outbreak of SARS-CoV-2 (≥ 39% infection prevalence), and 10 out of 13 LTCFs with a low prevalence of SARS-CoV-2 (≤ 39% infection prevalence) did implement the measure. This results in reduced odds of having a high-prevalence outbreak in facilities with the measure in place (OR 0.23, 95% CI 0.13-5.09).
Wilmink 2020		
Digital contact tracing as a response to an outbreak Exposed and pre-symptomatic individuals are assumed to be identified through digital contact tracing and isolated within 2.4 h **Context**: Assumed transmission rate implies limited infection control measures in place in the LTCF. Isolated individuals do not infect residents or staff.	**Measure vs no measure** Comparison of the outcome in a scenario with the measure of digital contact tracing and in a control scenario of symptom-mapping (isolation of infected individuals showing symptoms with a delay of 1 day)	**1. Number of infections** **Proportion of infected residents and staff at day 90** ***Direction of effect favours the measure (▲)*** Conducting digital contact tracing in an outbreak led to a lower number of infections at day 90 (3% of residents and staff) in comparison with isolation of symptomatic cases only (81% of residents and staff). (Data extracted from plot.) **5. Number of deaths** **Mortality rate of residents and staff at day 90** ***Direction of effect favours the measure (▲)*** Conducting digital contact tracing in an outbreak led to a lower mortality rate at day 90 (3% of residents and staff) in comparison with isolation of symptomatic cases only (24% of residents and staff). (Data extracted from plot.)

aOR: adjusted odds ratio; CI: confidence interval; **LTCFs:** long-term care facilities; **PPE:** personal protective equipment; **SD:** standard deviation;

Appendix 14. Multicomponent measures: study-by-study results summaries

Intervention category: short description	Comparison: short description and context	Outcome category: description and overview of direction
Nguyen 2020		
Multicomponent entry regulation, contact-regulation, and transmission-reducing measure Control measures in place include the isolation of symptomatic cases and testing of new admissions (2 tests), social distancing and restricted visiting **Context** No infection control measures in place	**Measure vs no measure** Comparison of outcome across 100 iterations of a scenario with the measures and a scenario without any measure (no baseline infection control measures)	**1. Number of infections** **Cumulative number of infections among residents over 90 days** ***Direction of effect favours the measures (▲)*** Implementing and adhering to a multicomponent entry regulation, transmission, and contact control measure showed lower mean and median cumulative number of infections among residents across 100 iterations of the scenario with the measure (mean: 53/80 residents, median: 53/80; IQR: 49-57) in comparison with the scenario without the measure (mean: 74/80 residents, median: 75/80; IQR: 70-79) after a follow-up of 90 days. The 95% CI of the difference 20.4 to 22.4, P value < 0.01 (Welch's t-test; 2 tailed; including Bonferroni correction)
Lipsitz 2020		
Multicomponent outbreak control measure Multicomponent audit score which consists of 28 infection-control competencies was taken as a proxy for the implementation of multiple measures in LTCFs (i. e. use of PPE, cohorting, screening, training of staff, general guidance on how to deal with infected individuals) **Context** Measures were implemented as part of a large multicomponent measure intended to increase the implementation and adherence of infection-control measures in LTCFs through providing training, audits, and resources to LTCFs.	**Measure vs no measure** Comparison of the outcome in LTCFs with implementation of a mask and PPE use order and those LTCFs without such an order based on weekly data from 123 LTCFs Analysis did adjust for one other measure — cohorting of residents — and for infection rate in the community.	**1. Number of infections** **Mean weekly infection rates** ***Direction of effect favours the measures (▲)*** Implementing multicomponent outbreak measures showed a decrease in mean weekly infection rates (β coefficient: −0.08, 95% CI −0.12 to −0.03) within LTCFs with measure implementation compared with LTCFs without implementation. **1. Number of infections** **Odds of having a weekly infection rate of zero infections** ***Direction of effect favours the measures (▲)*** Implementing multicomponent outbreak measures showed increased odds of zero infections within LTCFs with measure implementation compared to LTCFs without measure implementation (aOR 1.13, 95% CI 1.04 to 1.23) **5. Number of deaths** **Mean weekly mortality rates** ***Direction of effect favours the measure s (▲)*** Implementing multicomponent outbreak measures showed a decrease in mean weekly mortality rates (β coefficient: −0.30, 95% CI −0.09 to 0.02) within LTCFs with measure implementation compared with LTCFs without implementation. **5. Number of deaths** **Odds of having a weekly mortality rate of zero deaths** ***Direction of effect favours the measure s (▲)*** Implementing multicomponent outbreak measures showed increased odds of zero deaths within LTCFs with measure implementation compared to LTCFs without measure implementation (aOR 1.16, 95% CI 1.06 to 1.27)
Vijh 2021		
Multicomponent outbreak control measure	**Measure vs no measure**	**1. Number of infections** **Number of SARS-CoV-2 infections among residents**

(Continued)

Implementation of a multicomponent measure consisting of 4 main infection-control measures: case and contact management, proactive case detection, rigorous infection-control practices and resource prioritisation and stewardship	Interrupted time series assessing the change in trends following the implementation of the measure and a 14-day lag time in 7 LTCFs which received the measure	***Direction of effect favours the measures (▲)*** Implementing a multicomponent measure consisting of 4 main infection-control measures showed a reduction in the post-measure trend of COVID-19 rates. Average daily change in the rate of COVID-19 during the postintervention period (starting 14 days after the intervention). It found a significant trend change for the number of infections among residents (rate ratio: 0.72, 95% CI 0.65 to 0.80; p-value: <0.0001) after the implementation of the measure.
		1. Number of infections **Number of SARS-CoV-2 infections among staff** ***Direction of effect favours the measures (▲)*** A mixed-effect segmented Poisson regression model showed a reduction in the post-measure trend of COVID-19 rates. Average daily change in the rate of COVID-19 during the postintervention period (starting 14 days after the intervention). It found a significant trend change for the number of infections among staff (rate ratio: 0.77, 95% CI 0.65 to 0.90; p-value: <0.01) after the implementation of the measure.

aOR: adjusted odds ratio; **CI:** confidence interval; **IQR:** interquartile range; **LTCFs:** long-term care facilities; **PPE:** personal protective equipment

Appendix 15. Literature reviews and guidelines used for forward and backward searches

Bethell 2021: Social Connection in Long-Term Care Homes: A Scoping Review of Published Research on the Mental Health Impacts and Potential Strategies During COVID-19. J Journal of the American Medical Directors Association 22(2): 228-237.

Bolt 2021: Practical nursing recommendations for palliative care for people with dementia living in long-term care facilities during the COVID-19 pandemic: A rapid scoping review. Int J Nurs Stud 2020 113: 103781.

Brito-Brito 2020: [Nursing care for controlling coronavirus infections in positive cases: a narrative review.]. J Enferm Clin(31): 68-72.

D'Cruz 2020: 'An invisible human rights crisis': The marginalization of older adults during the COVID-19 pandemic - An advocacy review. Psychiatry Res 2020;292:113369.

Estabrooks 2020: Restoring trust: COVID-19 and the future of long-term care in Canada. J Facets 5(1): 651-691.

Fischer 2020: [COVID-19 protection measures in care homes]. Pflege 2020;33(4):199-206.

Frazer 2020a: Involvement of the open-source community in combating the worldwide COVID-19 pandemic: a review. J Med Eng Technol 2020:1-8.

Gmehlin 2020: COVID-19 in Long Term Care Facilities: A Review of Epidemiology, Clinical Presentations, and Containment Interventions. Infect Control Hosp Epidemiol 2020:1-21.

Gorenko 2021: Social Isolation and Psychological Distress Among Older Adults Related to COVID-19: A Narrative Review of Remotely-Delivered Interventions and Recommendations. J Journal of applied gerontology. 40(1): 3-13.

INSSS 2020: COVID-19 and distance socializing between people living in a residential facility and caregivers in the context of a visitors ban. Institut National d' Excellence en Santé et en Services Sociaux (INESSS), 2020.

Kunkle 2020: Formal Caregiver Burden in Nursing Homes: An Integrative Review. West J Nurs Res. 2020 Dec 27:193945920979691.

Lekamwasam 2020: Effects of covid-19 pandemic on health and wellbeing of older people: A comprehensive review. Ann Geriat Med Res 2020;24(3):166-72.

Mobasseri 2020: he Main Issues and Challenges Older Adults Face in the SARS-CoV-2 Pandemic: A Scoping Review of Literature. Iranian Journal of Public Health 49(12): 2295-2307.

Mok 2020: Tackling challenges in care of Alzheimer's disease and other dementias amid the COVID-19 pandemic, now and in the future. J Alzheimer's and Dementia 16(11): 1571-1581.

NCCMT 2020: What risk factors are associated with COVID-19 outbreaks and mortality in long-term care facilities and what strategies mitigate risk? National Collaborating Centre for Methods and Tools, School of Nursing, McMaster University (Canada).

Olry de Labry-Lima 2020: The use of masks to protect against respiratory infections: an umbrella review. J Enfermedades Infecciosas y Microbiologia Clinica, 20:S0213-005X(20)30262-7.

Perrotta 2020: COVID-19 and the elderly: insights into pathogenesis and clinical decision-making." J Aging Clinical and Experimental Research 32(8): 1599-1608

Yanes-Lane 2020: Proportion of asymptomatic infection among COVID-19 positive people and their transmission potential: A systematic review and meta-analysis. J PLoS ONE 2020;15(11):e0241536.

Perrotta 2020: COVID-19 and the elderly: insights into pathogenesis and clinical decision-making." 32(8): 1599-1608.

Salcher-Konrad 2020: COVID-19 related mortality and spread of disease in long-term care: a living systematic review of emerging evidence. medRxiv; 2020.06.09.20125237.

Simonetti 2020: Neuropsychiatric Symptoms in Elderly With Dementia During COVID-19 Pandemic: Definition, Treatment, and Future Directions. 11: 579842

Thompson 2020: The Impact of COVID-19 Pandemic on Long-Term Care Facilities Worldwide: An Overview on International Issues. 2020: 8870249.

Rios 2020: Preventing the transmission of COVID-19 and other coronaviruses in older adults aged 60 years and above living in long-term care: A rapid review. Syst Rev 2020;9(1):218.

Wang 2020: Use the Environment to Prevent and Control COVID-19 in Senior-Living Facilities: An Analysis of the Guidelines Used in China. HERD 2020;14(1):1937586720953519.

WHO 2020a: Preventing and managing COVID-19 across long-term care services. Policy brief. 24 July 2020. Geneva: World Health Organization (WHO/2019-nCoV/Policy_Brief/Long-term_Care/2020.1) 2020.

HISTORY

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CONTRIBUTIONS OF AUTHORS

JMS, RB, AM, and BV put together the report. All other review authors are listed in alphabetical order, with everyone making substantial intellectual contribution.

Protocol development: JMS and RB developed the protocol and coordinated the entire review process with substantial input from AM. JB, LA, KG, AK, JS, KW, AM all contributed to the protocol.

Searches: IM developed the search strategy with contribution from JMS, and conducted the searches. MIM (acknowledgements) reviewed the search strategy.

Title and abstract screening: JMS, RB, KG, AK, SL, JS, and KW conducted the title and abstract, with support from AM

Full-text screening: JMS, RB, LA, KG, AK, SL, JS, SV, and KW conducted the title and abstract, with support from AM and JB.

Data extraction: TL, CK, AB, and JMS conducted the data extraction for modelling studies. JMS, RB, LA, AK, SL, JS, BV, SV, and KW conducted data extraction for the observational studies.

Risk of bias/quality assessment: TL, CK, and AB conducted the data extraction for modelling studies, in discussion with JMS and JB. JMS, RB, AK, BV, SL, JS, and SV conducted the risk of bias assessment for the observational studies.

GRADE assessment: JMS prepared a first draft of the GRADE assessment, which was critically assessed and revised by TL, CK, and AB, and JB for modelling studies and RB, AM, BV, and JB for the observational studies.

Evidence synthesis: JMS, LA, RB, AM, and BV conducted the evidence synthesis.

Manuscript preparation: JMS, LA, RB, AM, and BV prepared the manuscript. All authors reviewed and revised the manuscript.

DECLARATIONS OF INTEREST

Jan M Stratil: the Chair for Public Health and Health Services Research at the Institute for Medical Information Processing, Biometry and Epidemiology received funding from the German Federal Ministry of Education and Research (BMBF) as part of the COVID-19 evidence ecosystem (CEOsys) project. No other conflicts of interest are known.

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DIFFERENCES BETWEEN PROTOCOL AND REVIEW

There are a few differences between the review protocol (Stratil 2021), and some sections of the review.

Criteria for considering studies: in the review protocol, we provide a number of intervention categories within four intervention domains that we expected to identify. However, based on the available evidence, we identified only a few of these categories, and many measures we had to classify into new emergent categories. However, all these new categories fit well within the four domains of intervention we prespecified in the protocol. In the review, we specify only one additional domain describing combinations of the measures from the other four domains.

Outcome measures: in the review protocol, we specified selecting only one outcome measure per study. However, given the fact that studies reported multiple relevant outcome measures, we decided to not apply this in practice.

Sensitivity analysis: in the review protocol, we specified conducting sensitivity analysis based on the study design and overall risk of bias of the study. We do not report sensitivity analyses in the review, as the bodies of evidence were small predominantly comprising 1 or 2 studies, and most studies had substantive methodological limitations.