Scientific Advisory Group

COVID-19 Scientific Advisory Group Rapid Evidence Report

Effectiveness of Screening Programs for Reducing the Spread of COVID-19 in Healthcare Settings [Update]

16 June 2022

Table of contents

Lay Summary

BACKGROUND

- The AHS “Fit For Work” screening program was implemented in late March 2020
- AHS staff, physicians, students, volunteers, and visitors are required to be screened for COVID-19 symptoms and risk factors at the front doors of AHS patient care sites. Screening stations at entry points involve symptom questionnaire, hand hygiene, and provision of a medical grade mask.
- As COVID-19 is circulating at high levels in the community and other public health restrictions have been lifted, the benefit of continued workplace screening programs is unclear.
- Over time, people will get tired of screening processes and start to ignore them. It is important to balance the safety of staff and patients with a program that will make it easy for people to stay home if they are sick and get tested if necessary.
- This review is intended to help health system leaders make a decision about screening in AHS facilities.

KEY MESSAGES

- There was not enough evidence about workplace screening programs to make a judgement one way or another about their effectiveness
- In-person screening programs may be better at identifying people who are sick and stopping them from attending work while they have symptoms than programs that are based on an app or online tool.
- There was no evidence to show that screening programs are still effective with the highly transmissible Omicron variant of COVID-19 and now that a majority of healthcare workers are vaccinated.

RECOMMENDATIONS

- Collect data on screening program acceptance, staff screening effectiveness, visitor screening effectiveness, and outbreak investigations in order to design a strategy for controlling respiratory viruses in healthcare settings.
- Intermittently review the screening programs in place and adapt to the specific local context (eg. patient vulnerability, community transmission level, other measures in place, new variants).
- Promote a “Healthy Worker Culture” where staff are empowered to stay home when symptomatic and supported by organizational policies (eg. sick leave, flexible work assignments).

Authorship and Committee Members

Name	Contribution
Heather Sharpe	Writer (Evidence extraction, draft preparation, revisions)
Susanne King-Jones	Librarian (Literature search)
Alexander Doroshenko	Primary Reviewer
Kimberly Nickoriuk, Jeff Roe, James Silvius, Angela Almstrong, Stephen Tsekrekos, Uma Chandran	Secondary Reviewers
Lynora Saxinger, Scott Klarenbach, Braden Manns	Scientific Advisory Group chairs (oversight and leadership responsibility)
John Conly, Alexander Doroshenko, Shelley Duggan, Grant Innes, Elizabeth MacKay, Rosana Salvaterra, Lynora Saxinger, Jeremy Slobodan, Brandie Walker, Nathan Zelyas	Discussion, revision, and approval of document

Topic: Effectiveness of Screening Programs for Reducing the Spread of COVID-19 in Healthcare Settings [Update]

1. **Are COVID-19 workplace screening programs (WSP) effective in identifying healthcare workers and visitors with COVID-19 symptoms?**
2. **Is there evidence that WSPs reduce the risk of COVID-19 transmission within healthcare settings?**
3. **How does the effectiveness of WSPs vary based on the community prevalence of COVID-19?**
4. **Does health / symptom screening of visitors reduce the rates of in-hospital COVID-19 transmission to visitors or from visitors to patients?**

Context

- This review is to serve as an update of the June 2020 review. As such, this review is inclusive of research from June 2020 to May 2022 and will not duplicate descriptions of studies in the prior review. The previous review can be found here: https://www.albertahealthservices.ca/assets/info/ppih/if-ppih-covid-19-sag-effectiveness-of-workplace-screening-programs-rapid-review.pdf
- The “fit for work” screening program was put in place in AHS in late March 2020. Current screening applies to AHS staff, physicians, students and volunteers as well as visitors in all AHS patient care sites. Screening stations at entry points involve symptom questionnaire, hand hygiene, and provision of a medical grade mask.
- The effectiveness of the ‘fit for work’ screening program is of interest because of considerations around its added value compared with resources used to implement such program, particularly in the context of very high rates of Omicron transmission in community settings and in healthcare, coupled with lower rates of confirmed diagnoses. In this situation, entry screening may add little benefit because of an overall higher risk of transmission from undetected pauci-symptomatic individuals.
- The benefit of workplace screening programs needs to be assessed in the context of resources required, as the balance of these (degree of additional benefit and feasibility of resource allocation for WSP versus allocation for other transmission prevention supports) may vary over time.
- There are concerns that HCW may become less adherent to screening policies over time, so optimizing feasible screening processes in a way that encourages continued adherence and facilitates recommended testing and sick leave will be important in overall respiratory virus transmission management.
- The potential objectives of WSP include: reduce the risk of nosocomial transmission of COVID-19, promote appropriate use of personal protective

equipment in healthcare settings, and promote other public health measures, such as self-isolation during illness.

- Studies focused on serological testing for health care workers are not included in this review, as serologic testing is not in current use to identify active, potentially transmissible infection.
- Individual studies that addressed patient screening were excluded from this review, as were screening studies conducted in non-healthcare settings. Systematic reviews may have included otherwise excluded populations/settings. Whether workplace screening programs are additive in reducing health care transmission risk in settings of very high community transmission and infection prevalence, including the Omicron waves of 2022, is unclear. Additionally, several of the studies were conducted prior to the widespread dissemination of vaccinations, as well as prior to the emergence of the Omicron variant. This limits the generalizability of the results to the current pandemic management.

Key Messages from the Evidence Summary

- The two most common approaches to WSP in the literature are 1) symptom screening through in person or electronic surveys to identify symptomatic healthcare workers (HCWs), and 2) laboratory testing to identify COVID-19 positive asymptomatic HCWs most commonly (Reverse Transcriptase – Polymerase Chain Reaction (RT-PCR testing). Less common methods include temperature screening alone or in combination with entirely online self-reported symptom assessment.
- Although many organizations, including AHS, use self report instruments there were no published transmission outcome assessments of this approach; although one report suggested that implementation identified a large proportion of HCW who were going to work with mild symptoms (“presenteeism”) and facilitated access to testing and isolation information.
- Consistent with the June 2020 review, despite the widespread use of WSP for HCWs and visitors for COVID-19, there is insufficient evidence that directly answers the research questions of comparative effectiveness of various types of WSP in either identifying symptomatic individuals (HCWs and visitors) or reducing COVID-19 transmission in health care settings. WSP may limit transmission by reducing presenteeism (HCWs from attending work while symptomatic, related to issues such as related to staffing shortfalls, personal responsibility, or financial needs).
- Importantly, there is little outcome-based data on the additive benefit of these programs in healthcare settings after widespread vaccination or since emergence of the Omicron variant of concern (VOC) which is noted to be more transmissible despite infection control and public health precautions.

- In available literature, symptom assessment or temperature checks alone have low sensitivity of identifying individuals with COVID-19. Lab based screening programs are reported to have better sensitivity, but this is affected by frequency of testing and may be limited by feasibility and acceptability in high prevalence transmission periods. Some data suggests a combination of screening methods may be more appropriate, however evidence to support this is of low quality and the possible incremental benefit may be small and may vary with community transmission conditions.
- The risk to HCW of workplace based COVID transmission using present IPC and vaccination recommendations has been low and data suggest that most HCW risk is congruent with their contextual community- based risk. An AHS report determined that only 6% of COVID-19 cases among staff in a 3-month period (March-May 2021) likely contracted the virus in the workplace, similarly in April 2020-February 2021 13% of COVID-19 cases among staff were contracted in the workplace (Amin et al., 2022). More recent data would be advantageous to consider this context following the emergence of the Omicron variant which has exhibited overall higher transmissibility in community settings.

Committee Discussion

Committee members concluded that there was limited additional evidence published since the last review particularly with respect to effectiveness /added value of symptoms-based screening, although there were more studies evaluating testing-based screening. The impact of transmission of other respiratory viruses within healthcare setting (including influenza, RSV and others) is acknowledged and thus an overall strategy around respiratory virus risk assessment and instituting evidence-based and quality control program-oriented precautions was suggested. There was an agreement that reported studies may not reflect the current epidemiological situation of both higher transmission associated with Omicron variant and higher vaccination coverage. Committee members commented that collection and analysis of AHS data would be helpful to formulate and revise WSP screening policies and evaluate outcomes and processes.

Recommendations

This updated review did not identify sufficient new evidence to suggest direct changes to the recommendations from the prior version (June 2020), which also had limited evidence. The recommendations provided here are therefore based on expert opinion and are aimed at overall respiratory virus transmission management.

1. A transdisciplinary group (involving Infection Prevention and Control (IPC), Workplace Health and Safety (WHS) and Public Health) should be established (with

dedicated time/human resource support) to design processes to support an overall respiratory virus control strategy. This would involve the identification, collation and review of data around workplace screening and other control measures that interact to reduce transmission (eg. universal masking and distancing). Elements could include:

a) Assessing staff acceptance and self reported adherence to recommended symptom survey processes; establish and publicly report rotating audits of survey completion
b) Collecting survey result data (example proportion of HCW at work with symptoms, proportion directed to test or isolate by current guidelines), and estimate cases averted due to screening/following isolation guidance
c) Collecting results of visitor screening processes in current use (proportion of visitors found symptomatic if universally screened, number of visitors identified as symptomatic and excluded if done as a ward-based process)
d) Collating and reviewing results of hospital or long-term care respiratory virus outbreak investigations, and the impact of nosocomial respiratory virus transmission
e) Establishing or maintaining expedited processes for staff respiratory virus testing based on current recommendations (which may vary by circulating SARS-CoV-2 strain or by cocirculating viruses) and collecting staff virologic testing results
f) Reviewing existing WHS data on HCW infection, exposure sources, facility outbreak reports, nosocomial COVID-19 cases, and previous IPC data on other nosocomial respiratory virus (particularly influenza) transmission should be used to inform a baseline report.

2. Resources should be allocated to further establish a “Healthy Worker” culture in AHS, with clear institutional policies, communications, and worker supports to ensure staff can stay home when they feel unwell. These activities may include elements such as flexible and supportive sick leave pay policies, alternate call schedules in case of physician illness, allowance for flexible work assignments, protecting HCW privacy in case of illness, and an awareness campaign to reduce the stigma around staying home while symptomatic.

3. Intermittent review of workplace screening policies is suggested, as the context of pandemic and overall respiratory virus control strategies should adapt to modify intensity of screening or tailor screening in different risk areas. Considerations include:

    a. Estimated level of community transmission: In times of very high community transmission and/or transmission predominantly from pauci-symptomatic and asymptomatic individuals, the additive value of

screening (excluding testing) based on symptoms reporting may be limited. Community transmission assessment should include review of case numbers, hospitalizations, percent positivity, and wastewater data.

b. In the event of emergence of new Variant of Concern: enhanced screening should be considered to limit healthcare associated risk.
c. Health care setting: Some health care settings are more vulnerable by virtue of the types of patients being cared for as these patients may be at higher risk of infection and higher risk of severe outcomes. As such, higher level screening might be warranted in elder and long-term care, cancer care and hospital immunocompromised (transplant ward, hematology-oncology, renal ward) settings. More intensive screening may also be warranted in outbreak settings. In these settings, visitors who do not pass the screening process should be offered alternative ways to see loved ones, such as a virtual or outdoor visits.
d. What other measures are in place: For example, rolling back entry screening in favour of self performed electronic screening with intermittent audit by area managers may be reasonable as apart of a sequential approach in which other measures such as continuous masking are maintained initially. This allows the effect of sequential changes to be tracked if data processes are put in place.
e. As no evidence is available to support the exact determination of thresholds for screening program intensity, a combination of the above considerations should be used.

Practical Considerations

- There is limited evidence around the effectiveness of HCW and/or visitor screening on nosocomial transmission of COVID-19. Consistent with the approaches of other jurisdictions, it appears reasonable to recommend symptom screening to reduce presenteeism, using self-report (including electronic) or in person screening programs, with an access to testing and supports for isolation as per current guidelines. Additional measures (such as testing based screening) may be necessary during periods of elevated risk defined by variants' transmissibility, vaccine mismatch/escape, co-circulating viruses or other features.
- It may be more practical and less resource-intensive to develop processes for symptom screening for HCW and visitors by developing robust ward/unit level processes (of review of electronic symptom screens at attendance on the ward, or intermittent audit) rather than implementation at the level of facility entrance, however individuals would likely be exposed to other settings as they move throughout the building.

- A screening tool is a useful cue to remind individuals to self-monitor for symptoms of illness and can act as a guide for the basic questions they should be asking. A pilot of an electronic symptom screen for visitors, such as with an app or QR code (with a paper-based backup), could be considered with visitors informed their survey will be checked by staff.
- Temperature measurement should not be used as a standalone screening measure.
- There would be utility in determining a threshold and process for how AHS would return to normal respiratory virus screening management as the pandemic continues to evolve. In the absence of evidence, changes to screening policies should be accompanied by an evaluation of outcomes and processes to inform decision making.
- Additional review of literature around presenteeism in healthcare may be of value to identify any research gaps and inform the work if the respiratory virus control working group

Research Gaps

The following research gaps were identified that impact the recommendations in this report:

- There is little research that evaluates the effectiveness of COVID-19 WSP tools (including details of the screening questions used), and limited information regarding how the WSPs are employed (real-world vs. intended/modelled implementation). Much of the screening related literature for health care workers employs serial SARS-Co-V-2 testing, rather than self-administered symptom screening instruments. While these screening tools are widely used, there is not adequate evidence to demonstrate their effectiveness, and there is variability in process (such as in person vs. electronic reporting).
- Harms and equity considerations should be evaluated with all screening programs to ensure they do not cause undue harm to families and staff.
- No literature was identified that collated cross-Canada and international approaches to hospital screening.
- The lack of evidence on cost-effectiveness of these screening tools is another research gap. Additionally, it is not feasible to isolate the impact of WSP tools from other measures implemented such as continuous masking and vaccination, and we do not yet understand the burden of ‘screening fatigue’, where individuals do not thoroughly complete screening tools.
- There is limited evidence on effectiveness of HCW screening programs in relation to nosocomial transmission of COVID-19. Future studies should compare rates of nosocomial transmission in settings with different intensity or different modalities of HCW screening. These types of studies can complement data from

evaluation of on-going screening practices and can be used as parameters in mathematical models to improve their accuracy for future forecasting of possible transmission. Future research may compare the varied approaches of various jurisdictions/provinces.

- Modeling studies presented are out of date and do not reflect the current Alberta context in relation to vaccination uptake and the presence of SARS-CoV-2 variants. The existing research does not account for the high community transmission demonstrated during the Omicron variant outbreak.

Strength of Evidence

There is a robust and growing body of evidence related to the prevalence of COVID-19 in HCWs, assessed by RT-PCR testing. The utility of this testing for reducing nosocomial infection is not well documented. Additionally, while outside the scope of this review, there is growing knowledge related to serological testing of HCWs. There are no randomized clinical trials in this review, and most studies were observational cohort studies, with a risk of selection bias (voluntary screening). Several of the articles were descriptive in nature and did not provide evidence of effectiveness (for example, describing the development of a screening program). Modeling studies may not be an accurate reflection of real-world settings. The research evidence was largely consistent. One study received further editorial comments from readers, which is highlighted in this review.

There is no reason to believe that the evidence presented here would not be applicable to Alberta. The research comes from a wide variety of healthcare settings throughout the world, offering a wide breadth of perspectives.

Limitations of this review

This review has several limitations. Firstly, like the prior review, it was common that researchers referred to “screening” and “testing” synonymously in the literature, when they refer to different epidemiological activities. In addition, articles were limited to English, so evidence from non-English jurisdictions may have been missed.

Because COVID-19 is a novel disease, the published evidence is focused on clinical findings rather than policy findings at this stage of the pandemic. The majority of COVID-19 screening literature related to testing asymptomatic carriers of the virus rather than using symptoms to prevent transmission. Additionally, several of the studies were conducted prior to the widespread dissemination of vaccinations, as well as prior to the emergence of the Omicron variant. This limits the generalizability of the results to the current pandemic management.

Summary of Evidence

A total of 37 articles were included in the narrative synthesis below, from the initial literature search of 85 articles. Databases were searched for English-language articles

published between June 2020 to May 2022. Following the literature review, a total of seven articles were added ad hoc for a total of 44 articles. The full search strategy can be found in the appendix of this report.

Evidence from the secondary and grey literature

Bielicki and colleagues (2020) advise that some form of daily self screening for symptoms have been implemented for HCWs in various settings. They suggest the following advantages and disadvantages to symptom monitoring/screening for HCWs:

Symptom monitoring of HCWs	**Advantages**	**Disadvantages**
Active (such as at shift start or through telephone or email reporting)	• Support the reporting of signs and symptoms compatible with SARS-CoV-2 infection • Lead to earlier identification of symptomatic HCWs, and target testing • Serve as a chance to connect with HCWs about their wellbeing for ongoing support	• Resource intensive • Potential depletion of staff if minor symptoms lead to (self)isolation without SARS-CoV-2 testing • May drain resources, such as in cases of clusters of HCWs and in settings where large departments are dedicated to the care of patients with COVID-19
Self-monitoring	• Reduce the barrier to HCW SARS-CoV-2 testing • Involves the majority of HCWs in one facility, identifying cases among HCWs within and outside of the health-care setting • Supported with digital tools, such as apps or online portals	• May be unreliable if HCWs do not feel it is important or fully disclose relevant information, or view all symptoms as reportable • May cause (self)isolation without SARS-CoV-2 testing • Could be ineffective without instructions of who to contact and actions to take if symptomatic

The United States Centers for Disease Control (CDC) updated guidelines on the management of visitors to healthcare facilities suggests the following screening should be incorporated: “Visitors who are noted by healthcare facility staff to have fever or other symptoms of acute respiratory illness (e.g., cough or shortness of breath) should be instructed to leave the facility and seek care if needed (Center for Disease Control and Prevention, 2020).” The CDC advocate that during periods of community transmission, all visitors should be assessed before entering the healthcare facility for symptoms of COVID-19 (Center for Disease Control and Prevention, 2020). Visitor restrictions and screening are common/required in health care settings throughout Alberta and Canada.

Evidence from the Primary Literature

Are COVID-19 workplace screening programs effective in identifying symptomatic HCW and visitors?

There is insufficient evidence to demonstrate the effectiveness of WSP for identifying symptomatic individuals compared to no screening for HCWs and visitors.

Sensitivity and Specificity of Screening

A Cochrane rapid review was conducted to assess the effectiveness of universal screening for SARS-CoV-2 infection compared with no screening, and to assess the accuracy of universal screening in those that have not presented to clinical care for symptoms, including literature up to May 2020 (Viswanathan et al., 2020). While this review was not specific to the HCW or hospital visitor populations it was included in this report as it is the most recent and thorough review of the topic. The review included two modelling studies and 17 cohort studies that compared an index screening method (such as asking about symptoms, international travel, prior exposures, temperature screening) to a RT-PCR test. This review included a pre-print modelling study (Zhang & Cheng, 2020) of asymptomatic HCW in emergency room departments, that assumed constant transmission which was rated of low quality. On balance, available evidence in this review suggested non lab based screening methods had relatively low sensitivity but reasonable specificity (of symptom assessment, temperature assessment, or both). Risk assessment (travel, known exposure) had similarly low sensitivity but reasonable specificity.

Several studies have been conducted to screen HCW for SARS-CoV-2 using RT-PCR testing. A number of studies have described prevalence screening programs of HCW by laboratory testing which identified test positive asymptomatic HCW although transmission potential was not reported (Abdelmoniem et al., 2021; Caselli et al., 2021; Coppeta et al., 2020; Duan et al., 2020; Van Loon et al., 2021; Zhou et al., 2020)

Asymptomatic screening including health questionnaire, nasal swab and blood samples of HCWs shows infection rates generally consistent with local infection curves of the general population (Treibel et al., 2020), suggesting a dominant role of general community transmission over hospital exposure overall. Repeated screening of 263 HCWs SARS-CoV-2 negative at baseline resulted in 12 positive cases, all with at least mild symptoms (Goguet et al., 2022), suggesting that properly applied symptom screening could pick up these cases.

In a PCR based screening study in 2020, HCWs were allocated to asymptomatic, symptomatic, and contacts in symptomatic household arms for RT-PCR test screening. Reported positivity was 0.8% for the asymptomatic arm, and 1.7% for the symptomatic and household contact arms combined, which was much lower than previously reported

and corresponds to a decline in patient admissions for COVID-19 (3% HCW asymptomatic; 15.4% HCW symptomatic; 7.7% contact in symptomatic household) (Jones et al., 2020). In a letter Moynan et. al. (2020) advocate that there is a role for HCW testing, regardless of symptoms, reporting that on three hospital units with two or more positive patients, 26% of staff (32/126) were positive; with 44% being asymptomatic at the time of testing, with most developing symptoms within three days. This would suggest an early outbreak was detected. In Egypt 4,040 HCW across 12 hospitals were screened for COVID-19 using an online survey, RT-PCR, as well as serological testing (Mostafa et al., 2021). Over all 4.2% (n=170/4040; 95% CO: 3.6-4.9) tested positive; 3.4% in asymptomatic HCWs (n = 116/3424) and 8.8% of symptomatic HCWs (n=54/616; 95% CI: 6.7-11.3) (Mostafa et al., 2021).

Is there evidence that WSPs reduce the risk of COVID-19 transmission within healthcare settings?

There is limited evidence related to the effectiveness WSPs in reducing transmission within healthcare settings, with only modeling data and observational/descriptive studies available. Models with assumptions that are based on pre-vaccination and pre-Omicron conditions may have limited current applicability. Higher transmissibility of VoC, Omicron in some modelling may intuitively result in greater reduction of infection implying better WSP effectiveness, but only based on testing and moderated by vaccination uptake.

Symptom-based screening

Two studies describe electronic symptom screen surveys similar to those is use within AHS.

UCSF Health implemented a chat bot symptom screening interface for HCWs to alleviate issue with long waits at entry screening stations as HCW could display their electronic “entry pass” at the entrance” rather than answering screening question; of 271,324 screens completed over a 60-day period, 99.1% of HCW were cleared for work with no restrictions, 0.2% had workplace restrictions (requiring clearance letter) and 0.5% were asked to stay home from work (Judson et al., 2020).

In another an active screening study, HCW in a large Los Angeles based healthcare system were asked to completed daily electronic symptom screening surveys, enrolling 9446 HCW in the tracking survey between April 2-17 and 2020. Completion of daily screening over the two-week period was fairly low at 54%. However, 1,318 of the 5,035 (26%) of the HCWs who completed daily screens were symptomatic and were directed for testing. Importantly, eighty two percent of these indicated they were not currently staying home from work when first reporting symptoms, with the most common reason cited as mild symptoms (Lichtman et al., 2021). The authors suggested that this tool helped address “presenteeism” by directing mildly symptomatic HCW to call a hotline to arrange testing and assess return to work planning.

These studies suggest that online tool-based symptom screening can identify HCW with mild symptoms for testing and isolation although there is no outcome-based data on number of symptomatic workers who attended regardless, or on workplace transmission or infection rates.

Lab test-based screening

Evans et al., (2021) conducted a within-hospital transmission model of SARS-CoV-2, including patients and HCWs to quantify both the contribution of nosocomial infection to total infection burden and the effectiveness of periodic testing (testing methods were not specified) of HCWs (every 1, 7, 14 or 28 days) in the UK. The model determined daily testing is the most effective at reducing transmission, with a reduction of 103 transmissions over the entire simulation period (25.4% of total transmissions), however requires over 4 million tests to be performed over the simulation period for a single hospital, resulting in an efficiency rate of 0.0001 transmission event reductions per test. A second modelling study found regular lab based screening of HCW was effective but dependent upon sensitivity of testing used (Pham et al., 2021). For example, HCW screening every 3 days with perfect test sensitivity reduced reproduction number by 67%, with a maximum test positivity rate of 5%. HCW screening every 3 or 7 days assuming time-varying test sensitivities reduced RE by 9% and 3%, respectively. A third modeling study (Grassly et al., 2020) simulated the impact of testing and isolation strategies on transmission of COVID-19. They suggested weekly screening of HCWs and other high-risk groups regardless of symptoms status by RT-PCR could reduce their contribution to transmission by 23% (95% CI 16–40%) in the assumed conditions.

A modelling study by Zhang & Cheng, (2020b), examined periodic laboratory testing of asymptomatic healthcare workers in emergency departments and looking at reduction of infections among HCW and patients as outcome. With a lower transmission constant of 1.2 new infections per 10,000 people, weekly COVID-19 testing of healthcare workers (HCW) would reduce new HCW and patient infections by 3-5.9% and bi-weekly testing would reduce both by 1-2.1%. At a higher transmission constant of 3.6 new infections per 10,000 people, weekly testing would reduce infections by 11-23% and bi-weekly testing would reduce infections by 5.5-13%. However, current transmission parameters in the Omicron wave are far in excess of the modeled numbers, making generalizability of this research limited.

Screening of 5076 HCW with a lateral flow immunoassay antigen device (LFD) at home occurred from 18 November 2020 to 21 January 2021. A total of 284 of the 5076 secondary HCW had a positive LFD result, of which 259 had a paired RT-PCR test, with 244 positive (Lamb et al., 2021), demonstrating a PPV of 94%.

Lab Test-Based Screening and/or Symptom Screening

Referring symptomatic HCW for COVID-19 testing can reveal high rates of COVID-19 infection during elevated community transmission period, all screening studies should

be interpreted within the context of the community transmission at that time, which may impact generalizability of study results. A table of the evidence regarding symptom- and lab-based screening effectiveness is included in the appendix.

A Mexican occupational health program was established to reduce to reduce and control SARS-CoV-2 in 129 outpatient clinics, including HCW screening (randomly testing front-line HCWs by RT-PCR every week) and triage (all HCWs at clinic entrance had temperature and symptom assessment, with symptomatic individuals sent home for isolation and further evaluation) (Pineda-Santoyo et al., 2021). A total of 7,376 HCWs were enrolled (423 were lost to follow up), and 4,000 had RT-PCR tests completed, with 35.4% testing positive, hospitalization of 0.11% and a lethality of 0.04%. The authors state the reduced mortality compared to other health care settings in Mexico may have been impacted by the occupational screening and early intervention program (Pineda-Santoyo et al., 2021).

As part of an outbreak investigation in France, symptomatic HCW at two hospitals were referred for testing with a COVID-19 prevalence of 28% (251/866 symptomatic HCWs), with an attack rate of 2.8% (251/7916 total HCWs). Compliance to control measures were cited as reducing the risk of transmission (mask use, hand hygiene and PPE use), however the screening strategy was not evaluated (Contejean et al., 2021).

How does the effectiveness of WSPs vary based on the community prevalence of COVID-19?

The effectiveness of WSPs variability based on community prevalence is not adequately addressed in the literature. The text below summarizes two modeling studies that may help inform this question.

Most studies reported do not describe the context of community transmission although in some cases where results are reported as part of healthcare outbreaks it is inferred to be during high transmission periods where pretest probability of healthcare worker infection would be higher.

A 2020 modelling study evaluated the impact of universal testing as a screening strategy compared to universal PPE for HCW in a labour and delivery setting (Savitsky & Albright, 2020). They determined based upon a prevalence of 0.36% of COVID-19; universal PPE was more effective, however universal screening was preferred strategy due to the cost ($4,175,229 for universal PPE and $3,413,251 for universal screening) in a spontaneous and induced labour scenario (Savitsky & Albright, 2020). As community prevalence of COVID-19 rises, the cost effectiveness of universal PPE becomes more favourable.

Chin and team (2021) completed a simulation modeling study to determine the optimal frequency of viral testing in high-risk health care settings. They determined routine testing could substantially reduce risk of outbreaks, but may be required as often as

twice weekly. In settings with low community incidence, once a week may be sufficient, suggesting that HCW laboratory screening for SARS-CoV-2 effectiveness is impacted by the community prevalence.

Does health / symptom screening for visitors reduce the rates of in-hospital COVID-19 transmission to visitors or from visitors to patients?

Publications on visitor restriction policies is generally descriptive in nature (describing what restrictions are in place); there is a paucity of effectiveness information on visitor screening. However, one publication described that rollback of a visitor restriction policy which was part of an effective prevention bundle was not associated with a rebound in documented healthcare associated respiratory virus infection.

The European Society of Clinical Microbiology and Infectious Diseases developed consensus guidelines on screening, including the systematic testing of asymptomatic visitors/caregivers(Carrara et al., 2022). They indicated that universal laboratory testing of asymptomatic visitors at first hospital visit and regularly afterwards (3–7 days) should be used in special circumstances only, and is controversial, with very low supporting evidence (Carrara et al., 2022). Circumstances where it may be warranted include when there is a high level of community transmission or low vaccination rate, particularly in settings with vulnerable patients.

Visitor restrictions as part of COVID-19 prevention have been common in health care settings with sixty-five of the 70 (93%) of hospitals reviewed in a 2021 study having some visitor restriction policies in place (Jaswaney et al., 2021). What is less clear is the effectiveness of restrictions, specifically the visitor screening strategies implemented in reducing the rates of in-hospital COVID-19 transmission. In a survey of representatives of 36 paediatric hospitals, 7 (19%) hospitals actively screened all visitors (asking about presence of symptoms such as cough and fever) prior to the COVID-19 pandemic, 34 (94%) hospitals expanded their screening policy since the pandemic (Kitano et al., 2020). These changes included active screening (asking about symptoms) for all visitors (n = 19, 56%), entry screening (n = 9, 26%), and temperature screening (n = 8, 24%).

En Wee and colleagues (2021) described the Singapore infection control bundle, including visitor temperature and symptom screening, and suggest that it contributed to no patient/visitor to HCW transmission of SARS-CoV-2 (documented from February to May 2020). This bundle included universal masking, segregation of patients with respiratory virus symptoms, point of entry symptom and temperature screening, and visitor restrictions. Prior to COVID-19 the cumulative incidence of health care associated viral infections was 9.69 cases per-10,000 patient-days (989 cases; 1,020,463 patient-days). After infection prevention measures were introduced, the cumulative incidence of PCR-proven health care associated viral infections fell to 2.23

cases per-10,000 patient-days (15 cases; 67,335 patient-days; IRR = 0.23, 95% CI = 0.13-0.38, P < .001) Importantly, visitor restrictions were relaxed to allowing a single visitor in June, to two visitors in August 2020, then no limits with no significant increase in PCR proven healthcare associated respiratory viral infection rates. (En Wee et al., 2021). The authors concluded that “rollback of visitor restrictions and visitor limitations was not associated with a subsequent rebound in HA-RVI. Visitor management complements other infection prevention efforts and needs to be calibrated carefully taking into consideration patients' psychological well-being and prevention of infection transmission.”

In terms of community context, as of May 2020, the period during which no transmission from visitors was documented, the cumulative incidence of COVID-19 in Singapore was 3000 / million population which was relatively high during that period suggested the bundle was effective. Acceptance of infection control measures at a tertiary care children’s hospital (including screening tests of staff and visitors) was evaluated through a survey of 219 HCWs and 229 caregivers/visitors and found that the HCWs found the measures to be effective and appropriate, including screening of patients, caregivers/visitors and staff (Remppis et al., 2022). The survey was conducted from January 2020 until March 2021. Hospital staff also identified that visitor restriction and cancellation of scheduled treatments were perceived to be least effective, and presented a burden on patients and caregivers (Remppis et al., 2022). The measures were not evaluated for impact upon rates of in-hospital transmission, as only one in-hospital SAVRS-CoV-2 transmission occurred.

Evolving Evidence

The evidence to address these questions is generally limited to studies assessing HCW COVID-19 prevalence, descriptive or observational studies, and modeling studies. Most of the publications antedate the intensive community transmission rates of the Omicron VOC and many antedated health care worker vaccination programs. It is noted that screening programs both for HCWs and visitors are widely implemented in North America (and other jurisdictions), however the effectiveness of these programs, and their impact on nosocomial infections has not been adequately studied.

Appendix

List of Abbreviations

AHS: Alberta Health Services

CDC: Centers for Disease Control and Prevention

COVID-19: Coronavirus Disease-2019

HCW: Healthcare Worker

PPE: Personal Protective Equipment

RT-PCR: Reverse Transcriptase – Polymerase Chain Reaction

SAG: Scientific Advisory Group

WSP: Workplace Screening Program

Table of evidence for the effectiveness of symptom-based and lab-based workplace screening programs

Study	Screening Type	Setting	Participants	Results	Limitations
(Judson et al., 2020)	Symptom	UCSF Health	271,324 screens in 690 days	99.1% of HCW were cleared for work with no restrictions, 0.2% had workplace restrictions (requiring clearance letter) and 0.5% were asked to stay home from work	-lack of randomization due to rapid deployment -concerns about privacy -unable to validate responses as accurate
(Lichtman et al., 2021)	Symptom	Health care setting	5,035 HCWs	HCW completing a daily electronic survey (symptom screening tool) found 1,318 HCWs were symptomatic and were directed for testing, 82% of them indicated they were not currently staying home from work when first reporting symptoms, with the most common reason cited as mild symptoms	-no comparator group -survey tool was designed primarily for efficiency of use, therefore detailed analysis of demographic variables are not possible
(Evans et al., 2021)	Lab-based (modelling)	Health care setting	Patients and HCWs	Daily testing is the most effective at reducing transmission, with a reduction of 103 transmissions over the entire simulation period (25.4% of total transmissions)	-requires over 4 million tests to be performed over the simulation period for a single hospital -assumes 100% accuracy of testing -new modelling data should consider emergence of variants and uptake of vaccinations
(Pham et al., 2021)	Lab-based (modelling)	Health care setting	HCW	HCW screening every 3 days with perfect test sensitivity reduced reproduction number by 67%, with a maximum test positivity rate of 5%. HCW screening every 3 or 7 days assuming time-varying	-PPE use was found to be the most effective intervention at reducing HCW infection -patients and HCWs were

				test sensitivities reduced RE by 9% and 3%, respectively.	cohorted by unit/ward -is dependent upon the sensitivity of the testing used -new modelling data should consider uptake of vaccinations (this study referenced emergence of variants)
(Grassly et al., 2020)	Lab-based (modelling)	Health care setting	HCWs and high-risk groups	weekly screening regardless of symptoms status by RT-PCR could reduce their contribution to transmission by 23% (95% CI 16–40%) in the assumed conditions.	-further data on the impact of test and trace strategies of HCWs would inform the model -the study was published prior to widespread vaccination and Omicron variant.
(Zhang & Cheng, 2020)	Lab-based (modelling)	Health care setting (emergency departments)	Asymptomatic HCWs	After 180 days, with a transmission constant of 1.219e-4 new infections/person, weekly COVID-19 testing of HCWs would reduce HCW and patient infections by 3%-5.9%, and biweekly testing would reduce infections in both by 1%-2.1%. At a transmission constant of 3.660e-4 new infections/person, weekly testing would reduce infections by 11%-23% and biweekly testing would reduce infections by 5.5%-13%. At a lower transmission constant of 4.067e-5 new infections/person, weekly and biweekly COVID-19 testing for HCW would result in 1% and 0.5%-0.8% reduction in infections, respectively.	-HCWs are not typically isolated by unit/ward -actual transmission rates are unknown and variable -current transmission parameters related to the Omicron variant far in excess of the modeled numbers.

(Lamb et al., 2021)	Lab-based (lateral flow immunoassay antigen device (LFD))	Health care setting	HCWs	284 HCWs had positive LFD result, and a paired PCR test result occurred for 259/284 (91.2%). Of those, 244 had a positive RT-PCR test, resulting in a PPV of 94.21% (244/259, 95% CI 90.73% to 96.43%).	-Only positive LFD results were confirmed with PCR testing, unless the staff member developed symptoms. -The true negative rate and therefore negative predictive value is not known.
(Celebi et al., 2020)	Lab-based	Health care setting	703 HCWs	50 (7.1%) were found to be positive for SARS-CoV-2. The infection rate was higher among HCWs that worked in a COVID-19 specific unit (8.3%) compared with those that did not (3.4%) (RR=2.5, confidence interval = 1.06-5.65, P= .027). Factors that impacted transmission included: close contact in the home (P = .016), inappropriate use of PPE (P = .003), not using a mask in the breakroom (P =.000), eating within proximity of other HCWs (P = .003), and not social distancing (P = .003)	-the sensitivity of SARS-CoV-2 detection by RT-PCR in nasal swap samples was an average of 70% -data relied on self-report
(Pineda-Santoyo et al., 2021)	Lab-based	129 outpatient clinics	7,376 HCWs	4,000 RT-PCR completed. An incidence of 35.4%, hospitalization of 0.11% and a lethality of 0.04%	-lack of control group -inability to isolate effectiveness of screening from other measures implemented
(Contejean et al., 2021)	Lab-based	Health care setting	1,344 symptomatic HCWs were tested (RT-PCR)	28% positive for SARS-CoV-2.	Compliance to control measures were cited as reducing the risk of transmission (mask use, hand hygiene and PPE use), however the screening strategy was not evaluated

Methods

Literature Search

A literature search was conducted by Susanne King-Jones from Knowledge Resources Services (KRS) within the Knowledge Management Department of Alberta Health Services. KRS searched databases for articles published between June 2020 and May 2022 and included: Ovid MEDLINE, PubMed, TRIP Pro, Google Scholar, LitCOVID, WHO COVID-19 Research Database, Centre for Evidence-Based Medicine (CEBM), National Institute for Health and Care Excellence (NICE), medRxiv, Cochrane Library, EBSCO COVID-19 Information Portal, Centers for Disease Control and Prevention, and CADTH. The full search strategy is included below. Briefly, the search strategy involved combinations of the following concepts:

- COVID-19 and related respiratory illnesses
- Screening
- Healthcare worker / healthcare setting
- Visitors

Articles identified by KRS in their search were initially screened by the librarian for obvious irrelevance. 85 articles were identified by KRS with references and abstracts provided for further review. Articles were screened by title and abstract against the inclusion/exclusion criteria listed in Table 1 below. 85 articles underwent full-text review and a further 48 articles were excluded from the review in accordance with the inclusion/exclusion criteria stated below. 37 articles from the database search were included in the evidence review, and seven were included *ad hoc*.

Table 1. Inclusion and exclusion criteria for results of the literature search

Inclusion Criteria	Exclusion Criteria
- Any population - Describes screening model for COVID-19 - Screening is used in healthcare settings - Reports program outcomes or metrics - Reports program economic outcomes - Published June 2020-May 2022 - Any jurisdiction - Grey literature, systematic reviews, controlled studies, evaluation studies, conference abstracts/poster	- Article is not from a credible source - Article does not have a clear research question or issue - Presented data/evidence is not sufficient to address the research questions - Describes screening program for mental health, substance misuse, STIs, chronic disease, non-respiratory pathogen - Screening for disease in patients - Does not describe program outcomes or metrics - Routine disease screening programs (eg. for migrants, other non-HCW populations) - Public surveillance protocols - Describes implementation with no outcome metrics - Non-human study - Editorial, commentary, opinion-based letter, study protocol

Critical Evaluation of the Evidence

Exclusion criteria for study quality were adapted from the Mixed Methods Appraisal Tool (MMAT) (Hong et al., 2018). Potential articles were evaluated on three criteria: 1) Peer reviewed or from a reputable source; 2) Clear research question or issue; 3) Whether the presented data/evidence is appropriate to address the research question. Preprints and non peer-reviewed literature (such as commentaries and letters from credible journals) are not excluded out of hand due to the novelty of COVID-19 and the speed with which new evidence is available.

Table 2 below is a narrative summary of the body of evidence included in this review. The categories, format, and suggested information for inclusion were adapted from the Oxford Centre for Evidence-Based Medicine, the Cochrane Library, and the AGREE Trust (Urwin, Gavinder & Graziadio, 2020; Viswanathan et al, 2012; Wynants et al., 2020; Brouwers et al., 2010).

Table 2. Narrative overview of the literature included in this review.

	Description
Volume	44 articles were included in this review. Almost all studies were observational, however, 6 modelling studies and 2 systematic reviews were included in the literature.
Quality	There is robust data exploring screening HCWs for SARS-CoV-2 by RT-PCR testing, primarily reporting incidence. However, there is a significant research gap in identifying the impact HCW and/or visitor screening has on outcomes such as transmission within health care settings. • Modeling studies are present in the literature and may not truly represent human behavior, and are often setting specific.
Applicability	There is no reason to believe that the evidence presented here would not be applicable to Alberta. Most of the evidence comes from jurisdictions with highly developed healthcare systems with similar HCW ethical frameworks.
Consistency	The evidence was consistent. There were no obvious outliers or dissenting articles.

Search Strategy

Database(s): **Ovid MEDLINE(R) and In-Process & Other Non-Indexed Citations and Daily** June 2020-May 2022 **& Ovid Healthstar** 1966 to March 2020; **CINAHL Complete EBSCO & Google Scholar.**

Medline

#	Searches	Results
1	exp COVID-19/	159581
2	Mass Screening/	113351
3	screen*.ti,ab.	874745
4	(fit adj1 work).ti,ab.	30
5	(fitness adj1 work).ti,ab.	143
6	(return adj1 work).ti,ab.	139
7	Return to Work/	3349
8	2 or 3 or 4 or 5 or 6 or 7	908378
9	healthcare worker*.ti,ab.	17171
10	health care worker*.ti,ab.	16500
11	healthcare professionals.ti,ab.	29270
12	Medical Staff/	2862
13	*Personnel, Hospital/	9691
14	9 or 10 or 11 or 12 or 13	72519
15	1 and 8 and 14	608
16	testing.ti,ab.	633144
17	15 not 16	449
18	limit 17 to english language	438
19	limit 18 to yr="2020 -Current"	438
20	performance.ti,ab.	1139746

21	Effectiveness.ti,ab.	526206
22	Pandemics/pc [Prevention & Control]	13532
23	outcome*.ti,ab.	2078788
24	strateg*.ti,ab.	1335437
25	assessment*.ti,ab.	1231631
26	evaluat*.ti,ab.	4036060
27	detect*.ti,ab.	2607328
28	effect*.ti,ab.	7744402
29	prevent*.ti,ab.	1605031
30	20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29	14656426
31	19 and 30	333

Healthstar Ovid 1966 to March 2022

#	Searches	Results
1	exp COVID-19/	121113
2	Mass Screening/	112137
3	screen*.ti,ab.	488508
4	(fit adj1 work).ti,ab.	23
5	(fitness adj1 work).ti,ab.	129
6	(return adj1 work).ti,ab.	121
7	Return to Work/	3258
8	2 or 3 or 4 or 5 or 6 or 7	521807
9	healthcare worker*.ti,ab.	12598
10	health care worker*.ti,ab.	13383

11	healthcare professionals.ti,ab.	22246
12	Medical Staff/	2713
13	*Personnel, Hospital/	9146
14	9 or 10 or 11 or 12 or 13	57653
15	1 and 8 and 14	549
16	testing.ti,ab.	373723
17	15 not 16	408
18	limit 17 to english language	398
19	limit 18 to yr="2020 -Current"	398
20	performance.ti,ab.	575263
21	Effectiveness.ti,ab.	351390
22	Pandemics/pc [Prevention & Control]	12531
23	outcome*.ti,ab.	1508230
24	strateg*.ti,ab.	768936
25	assessment*.ti,ab.	826145
26	evaluat*.ti,ab.	2281731
27	detect*.ti,ab.	1080891
28	effect*.ti,ab.	3297871
29	prevent*.ti,ab.	895232
30	20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29	7153391
31	19 and 30	301

CINAHL Complete EBSCO

#	Query	Results
S9	S7 AND S8 Published Date: 20200101-20221231	68
S8	TI (healthcare workers or healthcare professional or healthcare provider or healthcare personnel or doctor or nurse) OR AB (healthcare workers or healthcare professional or healthcare provider or healthcare personnel or doctor or nurse)	511,819
S7	S1 AND S6	266
S6	S2 OR S3 OR S4 OR S5	14,853
S5	TI return to work OR AB return to work	5,563
S4	TI fit for work OR AB fit for work	187
S3	TI self-assess* OR AB self-assess*	8,818
S2	"symptom screening" OR "symptomatic screening" OR "asymptomatic screening"	332
S1	covid-19 or coronavirus or 2019-ncov or sars-cov-2 or cov-19	98,810

Google Scholar

(COVID-19 OR sars-cov-2 OR cov-19) AND ("symptom screening" OR "symptoma3c screening" OR "asymptoma3c screening" OR “return to work” OR “fit for work” OR) AND (“healthcare worker” OR health “care professionals” OR“medical staff”)

References

Abdelmoniem, R., Fouad, R., Shawky, S., Amer, K., Elnagdy, T., Hassan, W. A., Ali, A. M., Ezzelarab, M., Gaber, Y., Badary, H. A., Musa, S., Talaat, H., Kassem, A. M., & Tantawi, O. (2021). SARS-CoV-2 infection among asymptomatic healthcare workers of the emergency department in a tertiary care facility. *Journal of Clinical Virology : The Official Publication of the Pan American Society for Clinical Virology*, *134*, 104710. https://doi.org/https://dx.doi.org/10.1016/j.jcv.2020.104710

Amin, A., Corbet, K., & Robertson, L. (2022). *AHS Healthcare Worker COVID-19 Testing Dashboard Summary Report: March 1-may 31, 2021*.

Bielicki, J. A., Duval, X., Gobat, N., Goossens, H., Koopmans, M., Tacconelli, E., & van der Werf, S. (2020). Monitoring approaches for health-care workers during the COVID-19 pandemic. *The Lancet. Infectious Diseases*, *20*(10), e261–e267. https://doi.org/https://dx.doi.org/10.1016/S1473-3099(20)30458-8

Brouwers, M. C., Kho, M. E., Browman, G. P., Burgers, J. S., Cluzeau, F., Feder, G., Fervers, B., Graham, I. D., Grimshaw, J., Hanna, S. E., Littlejohns, P., Makarski, J., Zitzelsberger, L., & AGREE Next Steps Consortium (2010). AGREE II: advancing guideline development, reporting and evaluation in health care. *CMAJ : Canadian Medical Association journal = journal de l'Association medicale canadienne*, *182*(18), E839–E842. Retrieved from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3001530/

Carrara, E., Ong, D. S. Y., Hussein, K., Keske, S., Johansson, A. F., Presterl, E., Tsioutis, C., Tschudin-Sutter, S., & Tacconelli, E. (2022). ESCMID guidelines on testing for SARS-CoV-2 in asymptomatic individuals to prevent transmission in the health care setting. *Clinical Microbiology and Infection*, *28*(5), 672. https://doi.org/10.1016/J.CMI.2022.01.007

Caselli, D., Loconsole, D., Dario, R., Chironna, M., & Aricò, M. (2021). Effectiveness of Preventive Measures in Keeping Low Prevalence of SARS-CoV-2 Infection in Health Care Workers in a Referral Children's Hospital in Southern Italy. *Pediatric Reports 2021, Vol. 13, Pages 118-124*, *13*(1), 118–124. https://doi.org/10.3390/PEDIATRIC13010017

Center for Disease Control and Prevention. (2020). *Management of Visitors to Healthcare Facilities in the Context of COVID-19: Non-US Healthcare Settings | CDC*. https://www.cdc.gov/coronavirus/2019-ncov/hcp/non-us-settings/hcf-visitors.html

Chin, E. T., Huynh, B. Q., Chapman, L. A. C., Murrill, M., Basu, S., & Lo, N. C. (2021). Frequency of Routine Testing for Coronavirus Disease 2019 (COVID-19) in High-risk Healthcare Environments to Reduce Outbreaks. *Clinical Infectious Diseases*, *73*(9),

E3127–E3129. https://doi.org/10.1093/cid/ciaa1383

Contejean, A., Leporrier, J., Canoui, E., Alby-Laurent, F., Lafont, E., Beaudeau, L., Parize, P., Lecieux, F., Greffet, A., Cheron, G., Gauzit, R., Fourgeaud, J., L'Honneur, A.-S., Treluyer, J.-M., Charlier, C., Casetta, A., Frange, P., Leruez-Ville, M., Rozenberg, F., … Kerneis, S. (2021). Comparing Dynamics and Determinants of Severe Acute Respiratory Syndrome Coronavirus 2 Transmissions Among Healthcare Workers of Adult and Pediatric Settings in Central Paris. *Clinical Infectious Diseases : An Official Publication of the Infectious Diseases Society of America*, *72*(2), 257–264. https://doi.org/https://dx.doi.org/10.1093/cid/ciaa977

Coppeta, L., Somma, G., Ippoliti, L., Ferrari, C., D'Alessandro, I., Pietroiusti, A., & Trabucco Aurilio, M. (2020). Contact Screening for Healthcare Workers Exposed to Patients with COVID-19. *International Journal of Environmental Research and Public Health*, *17*(23). https://doi.org/https://dx.doi.org/10.3390/ijerph17239082

Duan, P., Deng, Z.-Q., Pan, Z.-Y., & Wang, Y.-P. (2020). Safety considerations during return to work in the context of stable COVID-19 epidemic control: an analysis of health screening results of all returned staff from a hospital. *Epidemiology and Infection*, *148*, e214–e214. https://doi.org/https://dx.doi.org/10.1017/S0950268820002150

En Wee, L., Philip Conceicao, E., Xiang-Ying Sim, J., Kyawt Aung, M., & Venkatachalam, I. (2021). The impact of visitor restrictions on health care-associated respiratory viral infections during the COVID-19 pandemic: Experience of a tertiary hospital in Singapore. *American Journal of Infection Control*, *49*, 134–135. https://doi.org/10.1016/j.ajic.2020.09.007

Evans, S., Agnew, E., Vynnycky, E., Stimson, J., Bhattacharya, A., Rooney, C., Warne, B., & Robotham, J. (2021). The impact of testing and infection prevention and control strategies on within-hospital transmission dynamics of COVID-19 in English hospitals. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *376*(1829), 20200268. https://doi.org/10.1098/rstb.2020.0268

Goguet, E., Powers III, J. H., Olsen, C. H., Tribble, D. R., Davies, J., Illinik, L., Jackson-Thompson, B. M., Hollis-Perry, M., Maiolatesi, S. E., Pollett, S., Duplessis, C. A., Wang, G., Ramsey, K. F., Reyes, A. E., Alcorta, Y., Wong, M. A., Ortega, O., Parmelee, E., Lindrose, A. R., … Mitre, E. (2022). Prospective Assessment of Symptoms to Evaluate Asymptomatic SARS-CoV-2 Infections in a Cohort of Health Care Workers. *Open Forum Infectious Diseases*, *9*(3), ofac030–ofac030. https://doi.org/10.1093/ofid/ofac030

Grassly, N. C., Pons-Salort, M., Parker, E. P. K., White, P. J., Ferguson, N. M., Ainslie, K., Baguelin, M., Bhatt, S., Boonyasiri, A., Brazeau, N., Cattarino, L., Coupland, H., Cucunuba, Z., Cuomo-Dannenburg, G., Dighe, A., Donnelly, C., van Elsland, S. L., FitzJohn, R., Flaxman, S., … Xi, X. (2020). Comparison of molecular testing strategies for COVID-19 control: a mathematical modelling study. *The Lancet. Infectious Diseases*,

20(12), 1381. https://doi.org/10.1016/S1473-3099(20)30630-7

Hong, Quan Nha et al. (2018). The Mixed Methods Appraisal Tool (MMAT) Version 2018 for Information Professionals and Researchers'. 1 Jan. 2018 : 285 – 291. Retrieved from: http://mixedmethodsappraisaltoolpublic.pbworks.com/w/file/fetch/127916259/MMAT_2018_criteria-manual_2018-08-01_ENG.pdf

Jaswaney, R., Davis, A., Cadigan, R. J., Waltz, M., Brassfield, E. R., Forcier, B., & Joyner, B. L. (2021). Hospital Policies during COVID-19: An Analysis of Visitor Restrictions. *Journal of Public Health Management and Practice*. https://doi.org/10.1097/PHH.0000000000001320

Jones, N. K., Rivett, L., Sparkes, D., Forrest, S., Sridhar, S., Young, J., Pereira-Dias, J., Cormie, C., Gill, H., Reynolds, N., Wantoch, M., Routledge, M., Warne, B., Levy, J., Jiménez, W. D. C., Samad, F. N. B., McNicholas, C., Ferris, M., Gray, J., … Samad, F. N. B. (2020). Effective control of sars-cov-2 transmission between healthcare workers during a period of diminished community prevalence of covid-19. *ELife*, *9*, 1–10. https://doi.org/10.7554/ELIFE.59391

Judson, T. J., Odisho, A. Y., Young, J. J., Bigazzi, O., Steuer, D., Gonzales, R., & Neinstein, A. B. (2020). Implementation of a digital chatbot to screen health system employees during the COVID-19 pandemic. *Journal of the American Medical Informatics Association : JAMIA*, *27*(9), 1450–1455. https://doi.org/https://dx.doi.org/10.1093/jamia/ocaa130

Kitano, T., Piché-Renaud, P. P., Groves, H. E., Streitenberger, L., Freeman, R., & Science, M. (2020). Visitor Restriction Policy on Pediatric Wards During Novel Coronavirus (COVID-19) Outbreak: A Survey Study Across North America. *Journal of the Pediatric Infectious Diseases Society*, *9*(6), 766–768. https://doi.org/10.1093/JPIDS/PIAA126

Lamb, G., Heskin, J., Randell, P., Mughal, N., Moore, L. S. P., Jones, R., Davies, G. W., & Rayment, M. (2021). Real-world evaluation of COVID-19 lateral flow device (LFD) mass-testing in healthcare workers at a London hospital; a prospective cohort analysis. *Journal of Infection*, *83*(4), 452–457. https://doi.org/10.1016/j.jinf.2021.07.038

Larese Filon, F., Purpuri, A., Camata, D., Bovenzi, M., Rui, F., Ronchese, F., De Michieli, P., Marcello, A., Poggianella, M., Confalonieri, M., Salton, F., Confalonieri, P., Ruscio, M., Belgrano, A., Segat, L., D'Agaro, P., & Negro, C. (2021). Low sensitivity of rapid tests detecting anti-CoV-2 IgG and IgM in health care workers' serum for COVID-19 screening. *La Medicina Del Lavoro*, *112*(5), 331–339. https://doi.org/https://dx.doi.org/10.23749/mdl.v112i5.11798

Lichtman, A., Greenblatt, E., Malenfant, J., & Kuo, A. (2021). Universal symptom

monitoring to address presenteeism in healthcare workers. *American Journal of Infection Control*, *49*(8), 1021–1023. https://doi.org/10.1016/j.ajic.2021.02.009

Mostafa, A., Kandil, S., El-Sayed, M. H., Girgis, S., Hafez, H., Yosef, M., Saber, S., Ezzelarab, H., Ramadan, M., Afifi, I., Hassan, F., Elsayed, S., Reda, A., Fattuh, D., Mahmoud, A., Mansour, A., Sabry, M., Habeb, P., Ebeid, F. S., … El-Meteini, M. (2021). Universal COVID-19 screening of 4040 health care workers in a resource-limited setting: an Egyptian pilot model in a university with 12 public hospitals and medical centers. *International Journal of Epidemiology*, *50*(1), 50–61. https://doi.org/10.1093/IJE/DYAA173

Moynan, D., Cagney, M., Dhuthaigh, A. N., Foley, M., Salter, A., Reidy, N., Reidy, P., de Barra, E., & Fitzpatrick, F. (2020). The role of healthcare staff COVID-19 screening in infection prevention & control. *Journal of Infection*, *81*(3), e53–e54. https://doi.org/10.1016/j.jinf.2020.06.057

Pham, T. M., Tahir, H., van de Wijgert, J. H. H. M., Van der Roest, B. R., Ellerbroek, P., Bonten, M. J. M., Bootsma, M. C. J., & Kretzschmar, M. E. (2021). Interventions to control nosocomial transmission of SARS-CoV-2: a modelling study. *BMC Medicine*, *19*(1), 211. https://doi.org/https://dx.doi.org/10.1186/s12916-021-02060-y

Pineda-Santoyo, C., Campos-Romero, A., Luna-Ruiz Esparza, M. A., Lopez-Luna, L. E., Sanchez-Zarate, M. E., Zepeda-Gonzalez, A., Fernandez-Rojas, M. A., & Alcantar-Fernandez, J. (2021). Control and Prevention of SARS-CoV-2 Outbreaks among Healthcare Workers from 129 Healthcare Facilities in Mexico. *International Journal of Environmental Research and Public Health*, *18*(22). https://doi.org/https://dx.doi.org/10.3390/ijerph182211772

Remppis, J., Hilberath, J., Ganzenmuller, T., Slavetinsky, C., Vasconcelos, M. K., Gnadig, M., Liese, J., Gopel, S., Lang, P., Heinzel, O., & Renk, H. (2022). Infection control of COVID-19 in pediatric tertiary care hospitals: challenges and implications for future pandemics. *BMC Pediatrics*, *22*(1), 229. https://doi.org/https://dx.doi.org/10.1186/s12887-022-03299-x

Savitsky, L. M., & Albright, C. M. (2020). Preventing COVID-19 Transmission on Labor and Delivery: A Decision Analysis. *American Journal of Perinatology*, *37*(10), 1031–1037. https://doi.org/https://dx.doi.org/10.1055/s-0040-1713647

Treibel, T. A., Manisty, C., Andiapen, M., Pade, C., Jensen, M., Fontana, M., Couto-Parada, X., Cutino-Moguel, T., Noursadeghi, M., & Moon, J. C. (2020). Asymptomatic health-care worker screening during the COVID-19 pandemic - Authors' reply. *Lancet (London, England)*, *396*(10260), 1394–1395. https://doi.org/https://dx.doi.org/10.1016/S0140-6736(20)32211-X

Urwin, S; Gavinder K, Graziadio S. (2020). What prognostic clinical risk prediction scores for COVID-19 are currently available for use in the community setting? Centre for Evidence-Based Medicine. Retrieved from: https://www.cebm.net/covid-19/what-prognostic-clinical-risk-prediction-scores-for-covid-19-are-currently-available-for-use-in-the-community-setting/

Van Loon, N., Verbrugghe, M., Cartuyvels, R., & Ramaekers, D. (2021). Diagnosis of COVID-19 Based on Symptomatic Analysis of Hospital Healthcare Workers in Belgium: Observational Study in a Large Belgian Tertiary Care Center During Early COVID-19 Outbreak. *Journal of Occupational and Environmental Medicine*, *63*(1), 27–31. https://doi.org/10.1097/JOM.0000000000002015

Viswanathan, M., Ansari, M. T., Berkman, N. D., Chang, S., Hartling, L., McPheeters, M., ... & Treadwell, J. R. (2012). Assessing the risk of bias of individual studies in systematic reviews of health care interventions. In *Methods guide for effectiveness and comparative effectiveness reviews [Internet]*. Agency for Healthcare Research and Quality (US). Retrieved from: https://www.ncbi.nlm.nih.gov/books/NBK91433/

Viswanathan, M., Kahwati, L., Jahn, B., Giger, K., Dobrescu, A. I., Hill, C., Klerings, I., Meixner, J., Persad, E., Teufer, B., & Gartlehner, G. (2020). Universal screening for SARS-CoV-2 infection: a rapid review. *The Cochrane Database of Systematic Reviews*, *9*(9). https://doi.org/10.1002/14651858.CD013718

Wynants, L., Van Calster, B., Bonten, M. M., Collins, G. S., Debray, T. P., De Vos, M., ... & Schuit, E. (2020). Prediction models for diagnosis and prognosis of covid-19 infection: systematic review and critical appraisal. *BMJ*, *369*. Retrieved from https://www.bmj.com/content/369/bmj.m1328.long

Zhang, Y., & Cheng, S. R. (2020). Evaluating the Need for Routine COVID-19 Testing of Emergency Department Staff: Quantitative Analysis. *JMIR Public Health Surveill 2020;6(4):E20260 Https://Publichealth.Jmir.Org/2020/4/E20260*, *6*(4), e20260. https://doi.org/10.2196/20260

Zhou, F., Li, J., Lu, M., Ma, L., Pan, Y., Liu, X., Zhu, X., Hu, C., Wu, S., Chen, L., Wang, Y., Wei, Y., Li, Y., Xu, H., Wang, X., & Cai, L. (2020). Tracing asymptomatic SARS-CoV-2 carriers among 3674 hospital staff:a cross-sectional survey. *EClinicalMedicine*, *26*, 100510. https://doi.org/10.1016/j.eclinm.2020.100510