COVID-19 Scientific Advisory Group
Rapid Evidence Report

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

1. **What is the effectiveness of different workplace screening programs (WSPs) for identifying symptomatic individuals, including those used by AHS, compared to no screening for both healthcare workers (HCWs) and visitors?**
2. **Is there evidence that WSPs reduce the risk of COVID-19 transmission within healthcare settings?**
3. **How does the effectiveness of WSPs, and their value to AHS (costs, number of symptomatic people detected, cases prevented), vary based on the community prevalence of the disease (eg. phase of the pandemic)?**
4. **Does health / symptom screening for visitors reduce the rates of in-hospital transmission to visitors or from visitors to patients and offer value to AHS?**

Context

- The “”fit for work” screening program was put in place in AHS in late March 2020 and continues across AHS as well as in other areas of health care, including continuing care and many contracted services. Screening applies to AHS staff and physicians, as well as visitors to acute and long-term care sites.
- The objectives of the screening program include: to prevent the nosocomial transmission of COVID-19, to augment the use of personal protective equipment in healthcare settings, and to promote other public health measures, such as self-isolation during illness.
- There are two main approaches to screening for front-line staff: a "paper" screening performed in person, at the site upon entry, and an online screening tool that is available to people with an AHS email address. Each method has pros and cons. Electronic screening may be less sensitive due to individual compliance and disclosure, while paper screening is resource-intensive and creates large amounts of staff screening reports that are difficult to manage, as they are stored as temporary health records.
- Temperature screening is used as an objective measure and was used briefly within AHS. Temperature measurements can slow down queues and touchless or disposable methods have been recommended to prevent disease transmission. The value of temperature screening for COVID-19 is not clear.
- The in-person screening process is a burden on the system, as it requires approximately 500 FTE across AHS to operate. These staff have been redeployed from other operational areas, which impacts the system’s ability to resume capacity.
- The screening program was developed and implemented rapidly. The relative lull in COVID-19 cases allows an opportunity to consider the program more carefully, identify best practices, and consider existing evidence on the topic.

Key Messages from the Evidence Summary

- While evidence is fairly robust from other communicable disease screening programs, there is very little evidence that directly relates to these research questions for COVID-19 specifically. As a result, in addition to the COVID-19 literature, evidence was included from MERS-CoV literature, pandemic influenza (H1N1) literature, travel screening literature, and tuberculosis (TB) literature. Grey literature was considered in addition to peer reviewed academic publications.
- Multifaceted screening programs appear to be the most effective for detecting staff illness. In healthcare settings, this could be a program that combines staff education with self-report symptom reporting, temperature detection, and lab-based testing. All types of staff screening for illness programs should be

augmented with supportive policies that reduce the stigma and other disincentives of taking sick days and provide for adequate numbers of sick days. Screening programs that rely on a single measure of illness, such as self-declarations OR temperature detection tend to be less sensitive due to a combination of human and environmental factors. Temperature screening by infrared thermography is highly variable and should not be used in the absence of other screening measures.

- The literature review captured articles on lab-based testing strategies for health care worker screening, so although outside the original question scope this information was included. Lab screening by RT-PCR or serology, may contribute to a holistic screening strategy to identify asymptomatic and recovered individuals, in addition to symptom-based screening that can only detect symptomatic individuals. Rapid diagnostic tests may play a role in this model, however, none developed for COVID-19 thus far have sufficient validity to ensure confidence in their results. Lab-based HCW screening would impact cost and labour requirements of the screening program and could have significant operational implications while results are pending or ambiguous with quarantine requirements.
- The evidence does not directly show that workplace screening by any single method reduces transmission of COVID-19. It can be hypothesized that a comprehensive symptom screening tool might limit transmission as it could stop ill HCWs from coming to the hospital. A modelling study suggested that periodic staff testing in conjunction with PPE may limit transmission of COVID-19 in healthcare settings, but this is limited by the assumptions made within the study. It is also known that some HCWs have reported being referred for COVID-19 testing at AHS staff screening ports just prior to their laboratory confirmed diagnosis with COVID-19 infection – the frequency of this is unknown.
- There is some evidence to show that there is a relationship between the usefulness of workplace screening programs and the community prevalence of disease in healthcare settings. Travel screening models have shown that entry and exit screening programs become more effective as the epidemic becomes more stable. It is unclear how closely this would be mimicked in community and healthcare settings.
- There was limited evidence regarding visitor screening. Two articles were retrieved, neither relating specifically to COVID-19, and both are confounded by concurrent hand hygiene initiatives. Regardless, both articles suggest that visitor screening can reduce the number of respiratory virus infections acquired in a healthcare setting. In addition, (personal correspondence from R. Harrison and S. Tsekrekos, Workplace Health & Safety, AHS), visitors were potentially linked to HCW infections in at least one acute care AHS outbreak and a patient case of COVID-19 within AHS in March-April 2020.
- The literature search did not capture any indirect benefits of screening programs, which may be posited to include heightened awareness, self monitoring for specific symptoms, and an affirmation that the organization wants to ensure ill HCWs are not at work.
- The utility of the AHS screening program data is limited due to the structure of the data and the mixed online & paper screening. Only electronic reports are captured, and each individual status is replaced rather than sequentially recorded. As a result, it is difficult to estimate the effectiveness of the screening program and correlate the findings with cost data.

Committee Discussion

The committee agreed that the content of the review accurately reflects the current state of evidence on this topic; however, suggested restructuring of the recommendations and practical guidance based on the research questions and the strength of the evidence specifically related to COVID-19. It was acknowledged that the information regarding lab-based screening programs for HCWs was outside the scope of the original questions as approved by the review requestors, but because it was represented in the literature and might inform the future direction of screening among HCW in some scenarios, it was included for the purposes of future consideration by Workplace Health and Safety. The groups also discussed the possibility that currently collected data from on-going screening may be used for program evaluation and identified important research gaps.

Recommendations

1. Given the lack of evidence related to the effectiveness of HCW screening on nosocomial transmission of COVID-19 to patients and staff, it is reasonable to recommend an electronic self-report screening program (such as the online tool employed by AHS) coupled with access to diagnostic testing as an appropriate screening method for periods of low COVID-19 transmission and community prevalence. In-person screening should be reassessed when community prevalence rises, though a specific threshold is not provided (see below).
2. It is recommended that the more specific COVID-19 symptom list in the current fitness to work tool be maintained, but that staff members should also be made aware of the general Alberta population recommendations to self monitor for the AHS expanded symptom list to guide need for testing.
3. Institutional policies and communications should be aligned to promote a "Healthy Worker" culture. 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.
4. Staff screening programs should be evaluated and reassessed based on program data and on current prevalence of COVID-19 in the community/referral region. Specifically, the AHS "fitness for work" process infrastructure should be supported to allow ongoing data reporting and evaluation. For example, the structure of the AHS internal database should be modified to increase the utility of the fitness to work data. Data outcomes could include elements such as the number of HCW screened and the proportion of who were identified for testing from fitness for work screening. More specifically, rather than replacing the "fitness for work" status after every report, a sequential log would allow for a more accurate tally of the staff who declared themselves "unfit" for any given shift or time period. In addition, ongoing evaluation of staff symptom declaration behaviours could also support ongoing refinement of the HCW screening processes for AHS. Increasing community prevalence should also prompt review of screening performance and policies. Taken together, these data would allow for cost and trend analysis for determining program effectiveness.

Practical Considerations

- Extrapolating from evidence available for screening for other pathogens and from recommendations from grey literature, a multifaceted approach of HCW screening that includes in-person symptoms screening may be beneficial for detecting ill individuals and preventing them from entering health facilities. As this evidence base is not robust, this is potentially more relevant in settings of significant community transmission and in health care settings with high-risk populations (such as in long-term care or oncology/transplant wards during respiratory virus outbreaks, or potentially in care areas when an outbreak has been declared or initial clustering of cases has been noted. Temperature measurements should only be implemented in combination with symptoms reporting or verification.
- When it is needed, it may be more practical and less resource-intensive to develop processes for in-person symptom screening for HCW and visitors by developing robust ward/unit level processes rather than implementation at the level of facility entrance.
- The threshold for increasing or decreasing the intensity of the HCW and visitor screening programs should be determined based on expert consensus and incorporating epidemiological information, which may include a combination of the effective reproductive number (Rt), community prevalence, and risks associated with the specific site/facility (e.g. detection of nosocomial transmission, declaration of outbreaks, data from current screening program evaluation). No evidence is available to support the exact determination of thresholds for screening program intensity.

Research gaps

Two key research gaps were identified that impact the recommendations in this report:

- There is limited evidence regarding the role of temperature measurements in HCW screening programs. Anecdotally, temperature was a useful measure of illness during the COVID-19 outbreak in Calgary, but robust data is not available and its use is operationally challenging. Future studies should examine the incremental benefits of different modalities of temperature measurements in a combined HCW screening programs specifically related to COVID-19
- There is limited evidence on effectiveness of HCW screening in relation to nosocomial transmission of COVID-19. Future studies should compare rates on 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.

Additional Notes

It is acknowledged that the following comments are outside the scope of the agreed-upon research questions. However, much of the literature identified in the search was related to lab-based staff screening programs rather than daily 'fitness for work' programs. Therefore this information is provided to inform AHS Workplace Health and Safety.

- Lab-based testing could play a role in a staff screening program; however, this is unlikely to be a feasible approach due to costs, lab capacity, labour requirements, and operational implications. Rapid diagnostic testing is not yet sufficiently accurate to replace a symptom-reporting approach and conventional RT-PCR would take too long to be useful as a daily screening activity. One potential approach to detect asymptomatic (or paucisymptomatic) individuals might be intermittent cross-sectional surveys of staff reporting themselves fit for work, rather than daily staff testing, particularly if institutional spread is detected and / or during an early significant surge of community cases within a zone.

Strength of Evidence

The body of evidence included in this review was relatively robust where the evidence was related to older epidemics and well-studied fields (travel screening, tuberculosis, MERV-CoV, and pandemic influenza (H1N1)). Evidence relating specifically to COVID-19 screening in HCWs was only identified in grey literature. There were few academic or peer reviewed publications on this topic specific to COVID-19. Grey literature was obtained from reputable sources and were of high quality. Studies relating to influenza-like Illness (ILI) surveillance screening in healthcare sites were at risk of selection bias, as the screening was often voluntary. TB screening literature and travel screening literature are relatively robust, with the benefit of large datasets to evaluate interventions and processes. However, modeling studies are frequent in the travel screening literature and may not truly represent human behavior. The evidence was largely consistent, with no obvious outliers or dissenting articles.

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

Limitations of this review

This review has several limitations. First, this is a very broad topic. An observation made while reviewing the evidence is that "screening" and "testing" are often used synonymously in the literature, when they refer to different epidemiological activities. The breadth of the question increased the noise present in the search and increases the possibility that relevant articles were missed. 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 around clinical findings rather than policy findings at this stage on the pandemic. The majority of COVID-19 screening literature related to testing asymptomatic carriers of the virus rather than using symptoms to prevent transmission. As a result, the bulk of the screening literature included in this report relates to MERS-CoV, influenza, TB or travel screening. We can only extrapolate the relatedness to the COVID-19 specific context in AHS. Key clinical differences such as the early illness transmissibility of COVID-19 as compared with MERS-CoV should be taken into consideration.

Summary of Evidence

47 articles were included in the narrative synthesis below, from the initial literature search of 125 articles. Databases were searched for English-language articles published between 2010 and 2020. Five studies were identified and included *ad hoc*. The full search strategy can be found in the appendix of this report. The most relevant evidence comes from the grey literature, while the primary literature can be used to inform the further development of the HCW screening program used in AHS.

Evidence from secondary and grey literature

Evidence relating specifically to COVID-19 screening in HCWs was identified in the grey literature, rather than in the primary literature. The grey literature included here does not directly answer the research questions but supports the overarching topic more generally.

The Center for Evidence-Based Practice (2020) recommends that a layered screening process be used, such as temperature combined with daily symptom reporting from staff. Likewise, the American Centres for Disease Control and Prevention (CDC) recommends a comprehensive strategy for healthcare workers that includes symptom monitoring, staff education, flexible & non-punitive sick leave policies, and public health awareness (Centers for Disease Control and Prevention, 2020). Much like the discussions regarding electronic screening, in-person screening, or a hybrid model in AHS (Personal Communication with Dr. Curtis Johnston), the CDC (2020) describes a passive, enhanced passive, or active model of HCW screening, each with pros and cons, but does not describe any evidence for one model over another.

Four reviews in the grey literature found that infrared temperature screening alone is ineffective for screening for illness, whether COVID-19 or other (Center for Evidence-Based Practice, 2020; ECRI, 2020; WorkSafe BC, 2020; CADTH, 2014). An older review by CADTH found that mass thermography using IR (and fever screening in general) has poor sensitivity, although was conducted to inform border screening techniques (CADTH, 2014). The evidence did not change in the intervening six years, as newer reviews show (ECRI, 2020). The Centre for Evidence-Based Practice (2020) suggests that temperature-based screening may be used with no-contact or personal thermometers, while a thorough review of IR temperature screening (ECRI, 2020) states that the evidence is unfavourable due to a combination of disease factors and the limits of the technique. WorkSafe BC (2020) concurs, suggesting that the evidence for thermal screening is weak and should only be used as part of a multifaceted screening program.

Evidence from the primary literature

What is the effectiveness of different workplace screening programs (WSPs) for identifying symptomatic individuals, including that used by AHS, compared to no screening for both HCW and visitors?

General workplace screening programs for employee wellness, like that used in AHS as part of the COVID-19 response, were poorly represented in the literature obtained by this search. Traveler screening is a somewhat analogous process, as it involves screening large numbers of people who may or may not have symptoms and who present a risk of transmitting disease. Screening models for tuberculosis (TB) are included here at the suggestion of the review requestors; however, the natural history of the disease and the screening process are markedly different from those used to screen for influenza-like illness for the purposes of outbreak control. These differences severely limit the applicability of TB screening models to the current COVID-19 context.

The workplace screening models for ILI (Influenza, COVID-19, and MERS-CoV) appear to be grouped into three types: general illness screening, where HCWs are required to report the presence or absence of symptoms as a matter of fitness for work; exposure-based screening, where HCWs are screened, tested, and quarantined based on a confirmed exposure to an infectious agent; and pre-emptive universal screening, where all HCWs at a facility or unit are screened for disease and those who test positive are quarantined.

One report was identified with a general staff screening program similar to AHS' staff screening. To control a MERS-CoV outbreak in a single hospital in Korea, Park et al. (2016) describe a program where staff were required to electronically report the presence or absence of influenza-like symptoms and body temperature twice daily and were screened by thermography prior to entering the hospital. However, these measures did not detect any cases that did not have a confirmed epidemiological link to the index cases within the hospital, suggesting that extensive contact tracing is a more effective way to detect potential infections in small outbreaks (Park et al., 2016).

The other ILI screening programs described in the literature fall into two categories: passive reporting and post-exposure testing, and screening for the purposes of surveillance. Passive reporting and post-exposure testing appears to be used to limit the number of HCWs who may be working while ill, however, it depends on staff self-awareness, integrity, and organizational policies to support ill staff members. It should be noted, however, that there is often stigma around taking time off work for mild symptoms (Hunter et al., 2020) and that supportive policies can help to limit presenteeism due to illness (Mermel et al., 2019). Passive symptom screening must also accurately reflect the symptoms of the disease – Chow et al. (2020) suggest that 17% of symptomatic cases were missed by narrow screening criteria of fever, cough, shortness of breath & sore throat. This is further supported by Tostmann et al. (2020), who found that the sensitivity of their screening model to detect COVID-19 increased when reportable symptoms were broadened to include anosmia, myalgia, fatigue, eye pain, and malaise and were weighted towards anosmia and myalgia. Symptom-based screening and subsequent testing described by Yombi et al. (2020) found that fever was an effective selection criterion for further testing. In this study 378 HCW were tested for COVID-19 and only 94/378 (25 %) tested positive. Of those who tested positive, 49/94(52%) had fever, while fever was present in only 63/284(22%) who tested negative (Yombi et al., 2020). However, fever was undefined by Yombi (2020), as they used a subjective assessment.

Surveillance models using diagnostic testing with proactive intent are resource intensive and only provide information about a single point in time and sensitivity will depend upon the disease prevalence. Khalil et al. (2020) describes a universal RT-PCR screening model in a London maternity hospital to quickly identify and isolate positive cases. This model allows confirmed negative cases to return to work and ensures positive cases and their contacts are isolated (Khalil et al. 2020). Of 266 staff members (>50% of the workforce) 47 (18%) were found to be positive; of these positive cases, 31 (66%) were symptomatic and 16 (34%) were asymptomatic (Khalil et al., 2020). Similar goals are described in Rivett et al. (2020), who describes a round of initial universal testing for HCWs & their household contacts that had a 5% positivity rate (n=1200) followed by a rolling serial screening program based on probability of exposure (Rivett et al., 2020). Universal serology testing was described for a single oncology unit in Brazil, where 4 of 62 HCWs tested positive (Ismael et al., preprint). Proactive surveillance has also been described for MERS-CoV, where of 5065 individuals screened following an outbreak, 108 cases were detected and able to be isolated (Memish et al., 2014). Exposure-based surveillance also exists. Amer et al. (2018) used HCW screening for MERS-CoV to identify links to super-spreaders by testing 879 HCWs and 179 patients, regardless of symptoms. Of note, similar mass screening programs have been undertaken in AHS long-term care facilities to control local outbreaks and would likely be applied in the future as a surveillance and outbreak control measure.

Surveillance models of screening can be leveraged to develop shield immunity among healthcare workers. Shield immunity is a relatively novel concept that proposes to limit interactions between susceptible individuals and infectious individuals by placing a recovered individual "in the way" (Weitz et al., 2020). Modelling studies have shown that shielding strategies can reduce the number of deaths and ICU beds in both high and low transmission conditions (Weitz et al., 2020). In healthcare, this could mean using serological testing and RT-PCR to confirm immunity and cessation of viral shedding to identify recovered individuals and deploy them to high-risk settings within the healthcare system (such as caring for those in long-term care or those who are hospitalized with COVID-19). However, correlation of seropositivity to immunity has not been confirmed for SARS-CoV-2 yet, although most studies support development of immunity post infection and there have not yet been convincing reinfection cases in the literature.

As mentioned above, tuberculosis screening is markedly different from ILI screening due to the objective methods that are available for TB screening, the fact that LTBI is asymptomatic and not felt to be transmissible, and the natural history of the disease. Screening often consists of symptom review and chest X-ray screening to rule out active disease first, and then either a tuberculin skin test (TST) or interferon-gamma release assay (IGRA) or chest X-ray review for signs of past TB. The TST is a skin test but it is known to have low specificity due to cross-reactivity with the Bacillus Calmette–Guérin tuberculosis vaccine and non-tuberculous mycobacteria (NTM), whereas IGRA is specific to *Mycobacterium tuberculosis* but is more expensive (Ledda et al., 2019). In comparative studies, the more expensive (but more specific) IGRA test resulted in improved compliance and improved clearance to work time (Foster-Chang, Manning & Chandler, 2014) and may be more cost-effective in the long term (Giri et al., 2014; del Campo et al., 2012). Screening effectiveness for TB is also affected by staff recognition of the disease in their region (Cheng et al., 2018). Targeted TB screening as described in the literature here generally follows a risk model – screening may occur more frequently if staff members work with high-risk patients, if staff members were born in countries with endemic TB, or if staff are newly hired (Napoli et al., 2017; Janagond et al., 2017; Moucaut et al., 2013; Torres Costa et al., 2011).

Traveler screening programs also offer lessons that may support screening programs in healthcare settings. A weak analogy can be drawn with airport traveler screening. Modelling studies for traveler screening have shown that entry screening (analogous to in-person screening at the site) has limited incremental benefit over exit screening (analogous to electronic screening prior to arrival at the site) (Clifford et al., 2020; Gostic et al., 2020; Quilty et al., 2020; Gold et al., 2019). Screening measures may still be ineffective due to false declarations, denying potential exposures, or taking antipyretic drugs to conceal fever (in the case of thermal screening) (Mouchtouri et al., 2019).

Self-declaration of infection and exposure risk are unreliable in travel screening (Huizer et al., 2015; Gostic et al., 2020; Mouchtouri et al., 2019; Hale et al., 2012; Sakaguchi et al., 2012). The true rate of unreported symptoms is unknown but could be reasonably expected to be low. Sakaguchi (2012) reports that 3 of 24 symptomatic passengers identified by rapid diagnostic testing did not declare symptoms; and other studies have reported that only 27% of passengers self-reported symptoms (Nishiura & Kamiya, 2011). Hale et al. (2012) suggests that self-declaration combined with visual inspection at border entry had an estimated sensitivity of 5.8%.

Fever screening models are highly variable in effectiveness and evidence is presented in the ECRI report on IR temperature screening (2020). To summarize, the evidence from validation studies and from evaluation studies is mixed at best and unfavourable at worst (ECRI, 2020). Thermography readings are influenced by operator, environment, and subject factors (Huizer et al., 2015; Chen et al., 2020; Gostic et al., 2015; Hogan, Shipman & Smith, 2015). Consequently, thermographic fever screening is a relatively insensitive method of identifying infected individuals (Cho et al., 2014; Mouchtouri et al., 2019; Hogan, Shipman & Smith, 2015; Jennings et al., 2015; Priest et al., 2015; Gunaratnam et al., 2014; Nishiura & Kamiya, 2011). As identified in the grey literature above, temperature screening alone should not be used as a screening tool to detect illness. Rather, temperature screening, if used, should be combined with symptom declarations and education & awareness campaigns (Huizer et al., 2015; Jennings et al., 2015; Nishiura & Kamiya, 2011; Cowling et al., 2010). Sensitivity of fever screening increased when it was combined with other vital signs, such as respiratory rate and heart rate (Sun et al., 2017). Sun and colleagues (2017) describe a travel screening model where all three signs are derived from facial temperatures and report sensitivity, specificity, negative predictive value, and positive predictive value at 87.5%, 100%, 91.7%, and 100%, respectively (n=38); however, the calculations for these values are unclear. This model is more feasible in healthcare settings than in travel settings and may be appropriate for high risk populations.

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

There was very limited evidence related to the role of workplace screening programs in limiting the spread of COVID-19 in healthcare settings. No direct evidence was found that answered this question. At best, it is hypothesized that effective screening programs may limit COVID-19 transmission.

In a study of healthcare workers with influenza-like symptoms in Washington State (USA), Chow and colleagues (2020) found that 65% of HCWs who developed COVID-19 disease reported working a median of two days while exhibiting flu-like symptoms. In this setting, HCWs were not required to report symptoms prior to starting their shift; rather, they were recommended for testing following symptom onset. Chow (2020) notes that the screening criteria broadcast to staff were important. Nearly 17% of symptomatic HCWs did not report fever, cough, shortness of breath, or sore throat; 10% of cases were missed when screening criteria were expanded to include myalgias and chills (Chow et al., 2020).

A modelling study by Evans et al. (in preprint) found that for English hospital settings, a model with periodic lab-based testing showed a reduction of HCW infection of up to 64%, attributable to periodic testing. HCW testing was said to have a moderate effect on transmission to patients (up to 14% fewer infections from HCWs) but a larger effect on HCWs (up to 65% fewer HCW to HCW transmissions, and 31% fewer HCW infections in total) (Evans et al., preprint).

In Brazil, an oncology unit conducted a universal COVID-19 serological study to identify HCWs who may present a risk to patients (Ismael et al., preprint). All staff were tested for anti-SARS-CoV-2 antibodies and further tested by RT-PCR if symptomatic; by this method, 4 of 62 staff were identified as positive (Ismael et al., preprint). Of note, staff members were tested by an unnamed lateral flow point-of care assay. Lateral flow assays in general have very little published data to support their accuracy (Abbasi, 2020). The authors claim that the absence of COVID-positive oncology patients is evidence of the success of their screening program and that they were able to diminish asymptomatic transmission of the virus (Ismael et al., preprint).

Taken together, Evans (preprint) and Ismael (preprint) suggest that healthcare worker testing, rather than symptom screening, may limit the transmission of COVID-19 within healthcare settings. This is supported by extrapolating the evidence presented in Chow that HCWs worked a median of two days with ILI symptoms in the absence of proactive screening (2020).

How does the effectiveness of WSPs, and their value to AHS (costs, number of symptomatic people detected, cases prevented), vary based on the community prevalence of the disease?

The majority of the evidence on the relationship between screening effectiveness and disease prevalence arises from evidence on travel screening, rather than HCW screening.

Notably, internal data from AHS does not offer a clear answer to this research question. Since the program was implemented, the number of electronic reports stored on the AHS dashboard states 1059 people reported “unfit” for work between April 1 and May 15 (of 14-23 000 reporting per day) (Personal Communication with Stephen Tsekrekos). However, the value is not static as the database updates the status at every shift, and the database does not include the status of staff refused work after in-person screening. The data is not a valid measure of the effectiveness of our screening model, and therefore cost estimates (a determinant of value) would be tenuous at best (Personal Communication with Dr. Stephen Tsekrekos).

In programs screening for COVID-19 and MERS in HCW, it has been suggested that screening programs that are used for surveillance (such as where positive cases are sought) are impacted by the local prevalence of the disease (as with screening programs in general) (Tostmann et al., 2020; Park et al., 2016). However, the evidence was limited for this topic. Tostmann (2020) uses secondary analysis to extrapolate from symptom screening forms. It has been suggested that routine asymptomatic testing may be a method of outbreak control during active phases of an outbreak. Treibel et al. (2020) identified positive cases over five consecutive weeks: 28 (7·1%; 95% CI 4·9–10·0) of 396 HCWs in week 1, 14 (4·9%; 3·0–8·1) of 284 HCWs in week 2, four (1·5%; 0·6–3·8) of 263 HCWs in week 3, four (1·5%; 0·6–3·8) of 267 HCWs in week 4, and three (1·1%, 0·4–3·2) of 269 HCWs in week 5. This study only assessed symptoms for 1 week before and 1 week after onset of sympotms so asymptomatic prolonged shedding was not excluded. Evidence from Spain and Italy also show a gradient of HCW seropositivity based on community prevalence of the disease (Sandri et al., preprint; Galan et al., preprint; Ollala et al., 2020). Taken together, these data suggest that more robust screening methods (such as lab-based testing) are effective for detecting infectious and recovered individuals even as the community prevalence varies (Sandri et al., preprint; Galan et al., preprint; Ollala et al., 2020; Treibel et al., 2020).

In tuberculosis screening, prevalence of disease increases the likelihood of exposure, and thus increases the relative effectiveness of the screen (Moucaut et al., 2013; del Campo et al., 2012; Vinkeles Melchers et al., 2013).

Accordingly, it has been shown that in low-incidence countries, it is more cost effective to use tests with lower specificity (thus, cheaper) test as a first-line screen and the more specific (and more expensive) test to confirm a positive result (Napoli et al., 2017; del Campo et al., 2012). Compared to no screening, all screening strategies based on employment status (ie. new hire, annual high-risk screening, triennial high-risk screening) were cost-effective, however, targeted screening is most likely to be cost effective at lower willingness-to-pay thresholds (Png et al., 2019). Cost effectiveness for TB screening has been shown to decrease as the sensitivity and specificity of the test decrease (Png et al., 2019).

Travel screening offers more defined evidence for this question. Modelling studies have shown that the ability of entry screening to identify travelers and delay exported outbreaks decreases at the beginning of an outbreak (when prevalence is low and there are few travelers) (Clifford et al., 2020; Gostic et al., 2020). It is estimated that arrival screening can detect a median of 30% (10-50%) of infected travelers in a growing outbreak and in a similar fraction in a stable epidemic (17-50%) (Gostic et al., 2020). Travel screening is expensive. Estimates from SARS, Pandemic Influenza H1N1 (2009), and Dengue screening suggest a cost of US$50,000 per case detected (Mouchtouri et al., 2019). Symptom screening (applicable in stable or declining epidemics) is more effective than risk exposure screening (applicable in growing epidemics), thus, screening becomes potentially more effective in stable epidemics (Gostic et al., 2015). Ultimately, the effectiveness of travel screening depends on many factors, such as the prevalence and detectability of infection, the quality of screening methods, whether there is a chance of detecting other diseases, and whether the source can be controlled (Huizer et al., 2015).

Does the health / symptom screening for visitors reduce the rates of in-hospital transmission to visitors or from visitors to patients and offer value to AHS?

Only two studies were identified that described the effectiveness of visitor screening on in-hospital transmission of disease, and neither of these studies were screening for COVID-19 (Linam et al., 2019; Mermel et al., 2019). In addition, neither study can conclusively link visitor screening to reduced transmission of respiratory viruses. Hand hygiene is a confounding factor in both studies and likely plays a role in disease transmission in both acute care and continuing care settings. Linam (2019) describes a visitor wellness screening and hand hygiene initiative in a neonatal intensive care unit (NICU) while Mermel (2019) describes a hospital-based initiative to screen visitors for symptoms of viral respiratory infections. Linam (2019) showed that during the screening period, there was an increase in visitor hand hygiene that was concurrent with a decrease of hospital-acquired respiratory virus infections (HARVIs) from 0.67 to 0.23 / 1000 patient-days (a decrease of 66%). The impact of screening on its own could not be determined, as a record of symptomatic visitors was not kept (Linam et al., 2019). Mermel (2019) compared the rate ratio for HARVIs in the period before and after a visitor screening initiative was implemented. Compared to the 2012-2017 year, the rate of HARVIs was greater in units that did not screen visitors during either season compared to those that did screen visitors during the 2017–2018 season; however, the difference was not statistically significant and was confounded by hand hygiene rates (which were higher on units with visitor screening (Mermel et al., 2019).

Evolving Evidence

The evidence for this question related to COVID-19 was sparse and does not appear to be growing quickly. It is possible that many organizations are conducting internal evaluations of the screening program and not publishing the data. The evidence related to MERS-CoV, pandemic influenza (H1N1), and travel screening is relatively robust and is not changing quickly. It may be useful to conduct a specific update for COVID-19 related evidence, but the update would not need to include evidence from other disease or screening contexts.

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Authorship and Committee Members

This report was written by Rachael Erdmann and scientifically reviewed by Alexander Doroshenko, Robyn Harrison (external reviewer), and Stephen Tsekrekos (external reviewer). The full Scientific Advisory Group was involved in discussion and revision of the document: Lynora Saxinger (co-chair), Braden Manns (co-chair), John Conly, Alexander Doroshenko, Shelley Duggan, Nelson Lee, Elizabeth MacKay, Andrew McRae, Jeremy Slobodan, James Talbot, Brandie Walker, and Nathan Zelyas.

Appendix

List of Abbreviations

AHS: Alberta Health Services

CADTH: Canadian Agency for Drugs and Technologies in Health

CDC: Centers for Disease Control and Prevention

COVID-19: Coronavirus Disease-2019

FTE: Full-time equivalent

HCW: Healthcare Worker

IGRA: Interferon-gamma Release Assay

ILI: Influenza-like Illness

KRS: Knowledge Resource Services

MERS-CoV: Middle East Respiratory Syndrome Coronavirus

PPE: Personal Protective Equipment

RT-PCR: Reverse Transcriptase – Polymerase Chain Reaction

SAG: Scientific Advisory Group

TB: Tuberculosis

TST: Tuberculin Skin Test

WSP: Workplace Screening Program

Methods

Literature Search

A literature search was conducted by Nicole Loroff from Knowledge Resources Services (KRS) within the Knowledge Management Department of Alberta Health Services. KRS searched databases for articles published between 2010 and 2020 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
- Screenng
- Healthcare worker / healthcare setting
- Airport / travel
- Communicable diseases and transmission
- Visitors

Articles identified by KRS in their search were initially screened by the librarian for obvious irrelevance. 125 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. 72 articles underwent full-text review and a further 25 articles were excluded from the review in accordance with the inclusion/exclusion criteria stated below. 47 articles from the database search were included in the evidence review, and five 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 transmissible, severe respiratory illness (includes SARS, MERS, COVID-19, influenza, TB) - Screening is used in healthcare settings, airports, other venues with high risk of disease transmission - Reports program outcomes or metrics - Reports program economic outcomes - Published 2010-2020 - 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	47 articles were included in this review. Almost all studies were observational, however, four modelling studies and three systematic reviews were included in the literature on travel screening, and one systematic review was included in the literature on tuberculosis screening.
Quality	The studies regarding travel screening, tuberculosis screening, MERS, and pandemic influenza (H1N1) were relatively robust. Studies relating to ILI surveillance screening in healthcare sites were at risk of selection bias, as the screening was often voluntary. The TB screening literature was more robust, as it is an older body of evidence with no time pressures to publish. The travel screening literature was also relatively robust, with the benefit of very large datasets to evaluate interventions and processes. However, modeling studies are frequent in the literature and may not truly represent human behavior.
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** 1946 to May 22, 2020 **& Ovid Healthstar** 1966 to March 2020
Search Strategy:

#	Searches	Results
1	exp Coronavirus/ or exp Coronavirus Infections/ or coronaviru*.mp. or "corona virus*".mp. or ncov*.mp. or n-cov*.mp. or "novel cov".mp. or COVID-19.mp. or COVID19.mp. or COVID-2019.mp. or COVID2019.mp. or SARS-CoV-2.mp. or SARSCoV-2.mp. or SARSCoV2.mp. or SARSCoV19.mp. or SARS-Cov-19.mp. or SARSCov-19.mp. or SARSCoV2019.mp. or SARS-Cov-2019.mp. or SARSCov-2019.mp. or "severe acute respiratory syndrome coronaviru*".mp. or "severe acute respiratory syndrome cov 2".mp. or "2019 ncov".mp. or 2019ncov.mp.	24741
2	Mass Screening/	102455
3	(screen* or WSP*).mp.	806600
4	2 or 3	806600
5	1 and 4	1103
6	limit 5 to english language	1020
7	limit 6 to yr="2019 -Current"	283
8	Workplace/ or Return to Work/ or exp Personnel, Hospital/ or exp Health Facilities/	849522
9	(work* or employe* or staff* or healthcare worker* or "health care worker*" or HCW* or hospital*).mp.	3373642
10	(health adj2 professional*).mp.	76119
11	8 or 9 or 10	3630305
12	7 and 11	103
13	(questionnaire* or assess* or self-assess* or "point of care test*" or "point-of-care test*").mp.	3612412

14	12 and 13	30
15	7 and 13	56
16	visitor*.mp.	11770
17	7 and 16	2
18	Airports/	440
19	(airport* or travel* or border or arena).mp.	135727
20	18 or 19	135727
21	7 and 20	28
22	4 and 11	141525
23	limit 22 to english language	131294
24	limit 23 to yr="2015 -Current"	52471
25	Severe Acute Respiratory Syndrome/ or SARS Virus/ or Middle East Respiratory Syndrome Coronavirus/ or Influenza A Virus, H1N1 Subtype/ or exp Tuberculosis/	212960
26	(SARS or MERS or SARS-Cov or MERS-Cov or H1N1 or TB or influenza or respiratory).mp.	701460
27	25 or 26	857321
28	24 and 27	2390
29	Pandemics/ or Disease Outbreaks/ or exp Disease Transmission, Infectious/ or Infection Control/ or exp Communicable Diseases/	199439
30	(transmit* or transmiss* or infectivity or infectiousness or communicable disease* or pandemic*).mp.	746118
31	29 or 30	828633
32	24 and 31	3162
33	4 and 20	4009
34	limit 33 to english language	3776
35	limit 34 to yr="2015 -Current"	1536
36	27 and 35	144
37	31 and 35	376
38	Workplace/ or Return to Work/ or exp Personnel, Hospital/	113396
39	(healthcare worker* or "health care worker*" or HCW* or medical staff).mp.	57682
40	38 or 39	145777
41	4 and 40	4153
42	limit 41 to english language	3801
43	limit 42 to yr="2015 -Current"	1364
44	(27 or 31) and 43	345
45	(symptom adj3 screening).mp.	616
46	(symptomatic adj3 screen*).mp.	509
47	(asymptomatic adj3 screen).mp.	241
48	45 or 46 or 47	1354
49	11 and 48	376
50	limit 49 to english language	362
51	limit 50 to yr="2015 -Current"	187
52	27 or 31	1618651
53	51 and 52	67
54	(fit* adj2 work).mp.	938
55	4 and 54	47
56	limit 55 to english language	36
57	limit 56 to yr="2015 -Current"	9

PubMed

#	Searches	Results
1	"coronavirus"[MeSH Terms] OR "coronavirus infections"[MeSH Terms] OR "coronaviru*"[Title/Abstract] OR "corona virus"[Title/Abstract] OR "ncov*"[Title/Abstract] OR "n cov*"[Title/Abstract] OR "novel cov"[Title/Abstract] OR "COVID-19"[Title/Abstract] OR "COVID19"[Title/Abstract] OR "COVID-2019"[Title/Abstract] OR "COVID2019"[Title/Abstract] OR "SARS-COV-2"[Title/Abstract] OR "SARSCOV-2"[Title/Abstract] OR "sarscov2 "[Title/Abstract] OR "SARSCOV19"[Title/Abstract] OR "sars cov 19 "[Title/Abstract] OR "severe acute respiratory syndrome cov 2"[Title/Abstract] OR "2019 ncov"[Title/Abstract] OR "2019ncov"[Title/Abstract] OR "severe acute respiratory disease"[Title/Abstract]	35264
2	"mass screening"[MeSH Terms] OR "screen*"[Title/Abstract] OR "wsp"[Title/Abstract]	784986
3	1 and 2	1492
4	limit 3 to english language	1396
5	limit 6 to yr="2019 -Current"	634
6	"workplace"[MeSH Terms] OR "return to work"[MeSH Terms] OR "personnel, hospital"[MeSH Terms] OR "health facilities"[MeSH Terms] OR work*[Title/Abstract] OR employe*[Title/Abstract] OR staff*[Title/Abstract] OR healthcare worker*[Title/Abstract] OR "health care worker*"[Title/Abstract] OR HCW[Title/Abstract] OR hospital*[Title/Abstract]	3496963
7	5 and 6	243
8	"pandemics"[MeSH Terms] OR "disease outbreaks"[MeSH Terms] OR "disease transmission, infectious"[MeSH Terms] OR "infection control"[MeSH Terms] OR "communicable diseases"[MeSH Terms] OR "transmit*"[Title/Abstract] OR "transmiss*"[Title/Abstract] OR "infectivity"[Title/Abstract] OR "infectiousness"[Title/Abstract] OR "communicable disease*"[Title/Abstract] OR "pandemic*"[Title/Abstract]	752970
9	7 and 8	172
10	questionnaire*[Title/Abstract] OR assess*[Title/Abstract] OR self-assess*[Title/Abstract] OR "point of care testing"[Title/Abstract] OR "point-of-care testing"[Title/Abstract]	3212147
11	7 and 10	56
12	visitor*[Title/Abstract]	10305
13	5 and 12	5
14	"airports"[MeSH Terms] OR "airport*"[Title/Abstract] OR "travel*"[Title/Abstract] OR "border"[Title/Abstract] OR "arena"[Title/Abstract]	126326
15	5 and 14	41
16	2 and 14	3869
17	limit 16 to english language	3677
18	limit 17 to yr="2015 -Current"	1434
19	8 and 18	327
20	"severe acute respiratory syndrome"[MeSH Terms] OR "sars virus"[MeSH Terms] OR "middle east respiratory syndrome coronavirus"[MeSH Terms] OR "influenza a virus, h1n1 subtype"[MeSH Terms] OR "tuberculosis"[MeSH Terms] OR "SARS"[Title/Abstract] OR "MERS"[Title/Abstract] OR "SARS-Cov"[Title/Abstract] OR "MERS-Cov"[Title/Abstract] OR "H1N1"[Title/Abstract] OR "TB"[Title/Abstract] OR "influenza"[Title/Abstract] OR "respiratory"[Title/Abstract]	734900
21	18 and 20	130
22	"workplace"[MeSH Terms] OR "return to work"[MeSH Terms] OR "personnel, hospital"[MeSH Terms] OR healthcare worker*[Title/Abstract] OR "health care worker*"[Title/Abstract] OR HCW[Title/Abstract] OR "medical staff"[Title/Abstract]	143241
23	2 and 22	4376
24	limit 23 to english language	4032
25	limit 24 to yr="2015 -Current"	1336
26	20 and 25	205
27	8 and 25	269
28	symptom screening[Title/Abstract] OR symptomatic screen*[Title/Abstract] OR asymptomatic screen*[Title/Abstract]	522
29	6 and 28	164

30	limit 29 to english language	157
31	limit 30 to yr="2015 -Current"	99
32	"fit for work"[Title/Abstract] OR "fit to work"[Title/Abstract] OR "fitness for work"[Title/Abstract] OR "fitness to work"[Title/Abstract] OR "return to work"[Title/Abstract]	9550
33	2 and 32	347
34	limit 33 to english language	324
35	limit 34 to yr="2015 -Current"	146

TRIP Pro/Google Scholar

("covid-19" OR coronavirus OR COVID19 OR “corona virus” OR ncov OR “n-cov” OR “covid-2019” OR covid2019 OR “SARS-COV-2” OR “sarscov-2” OR sarscov2 OR sarscov19 OR “sars-cov-19” or “sarscov-19” OR sarscov2019 OR “sars-cov-2019” OR “severe acute respiratory syndrome”) AND (screen*) from:2019

("covid-19" OR coronavirus OR COVID19 OR “corona virus” OR ncov OR “n-cov” OR “covid-2019” OR covid2019 OR “SARS-COV-2” OR “sarscov-2” OR sarscov2 OR sarscov19 OR “sars-cov-19” or “sarscov-19” OR sarscov2019 OR “sars-cov-2019” OR “severe acute respiratory syndrome”) AND (screen*) AND (work* or employe* or staff or visitor*) from:2019

("covid-19" OR coronavirus OR COVID19 OR “corona virus” OR ncov OR “n-cov” OR “covid-2019” OR covid2019 OR “SARS-COV-2” OR “sarscov-2” OR sarscov2 OR sarscov19 OR “sars-cov-19” or “sarscov-19” OR sarscov2019 OR “sars-cov-2019” OR “severe acute respiratory syndrome”) AND (screen*) AND (“health care worker” OR healthcare work* OR HCW* OR medical staff* OR hospital*) from:2019

("covid-19" OR coronavirus OR COVID19 OR “corona virus” OR ncov OR “n-cov” OR “covid-2019” OR covid2019 OR “SARS-COV-2” OR “sarscov-2” OR sarscov2 OR sarscov19 OR “sars-cov-19” or “sarscov-19” OR sarscov2019 OR “sars-cov-2019” OR “severe acute respiratory syndrome”) AND (screen*) AND (airport* or travel* or border* or arena) from:2019

(screening) AND (airports* OR travel* OR border* OR arena) AND (pandemic OR outbreak OR infectious OR “communicable disease” OR transmission OR SARS OR MERS OR H1N1 OR influenza OR tuberculosis) from:2015

(screening) AND(pandemic OR outbreak OR infectious OR “communicable disease” OR transmission OR SARS OR MERS OR H1N1 OR influenza OR tuberculosis) AND (“health care worker” OR healthcare work* OR HCW* OR medical staff*) from:2015

("symptom screening" OR "symptomatic screening" OR "asymptomatic screening") AND(pandemic OR outbreak OR infectious OR “communicable disease” OR transmission OR SARS OR MERS OR H1N1 OR influenza OR tuberculosis) AND (“health care worker” OR healthcare work* OR HCW* OR medical staff*) from:2015

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/CADTH

(screen or screened or screening or symptom screening or asymptomatic screening or work screening or healthcare worker screening or health personnel screening or hospital screening or airport screening)

A second search was conducted to expand the date range and include the concept of visitors

This strategy is below.

Database(s): **Ovid MEDLINE(R) and In-Process & Other Non-Indexed Citations and Daily** 1946 to May 27, 2020 & **Ovid Healthstar** 1966 to April 2020

Search Strategy:

#	Searches	Results
1	Mass Screening/	102496
2	screen*.mp.	802042
3	1 or 2	802042
4	Workplace/ or Return to Work/ or exp Personnel, Hospital/ or exp Health Facilities/	849938
5	(work* or employe* or staff* or healthcare worker* or "health care worker*" or HCW* or hospital*).mp.	3376203
6	(health adj2 professional*).mp.	76172
7	4 or 5 or 6	3633005
8	3 and 7	141155
9	limit 8 to english language	131285
10	limit 9 to yr="2010 - 2015"	37944
11	Severe Acute Respiratory Syndrome/ or SARS Virus/ or Middle East Respiratory Syndrome Coronavirus/ or Influenza A Virus, H1N1 Subtype/ or exp Tuberculosis/	213047
12	(SARS or MERS or SARS-Cov or MERS-Cov or H1N1 or TB or influenza or respiratory).mp.	702141
13	11 or 12	858033
14	10 and 13	1803
15	(questionnaire* or assess* or self-assess* or "point of care test*" or "point-of-care test*").mp.	3616149
16	14 and 15	695
17	limit 16 to "review articles"	82
18	(symptom* or symptomatic or asymptomatic).mp.	484918
19	14 and 18	150
20	Pandemics/ or Disease Outbreaks/ or exp Disease Transmission, Infectious/ or Infection Control/ or exp Communicable Diseases/	199898
21	(transmit* or transmiss* or infectivity or infectiousness or communicable disease* or pandemic*).mp.	747011
22	20 or 21	829567
23	10 and 22	2545
24	15 and 23	829
25	limit 24 to "review articles"	52
26	18 and 23	194
27	visitor*.mp.	11768
28	3 and 27	586
29	limit 28 to english language	552
30	limit 29 to yr="2010 -Current"	235
31	13 and 30	31
32	22 and 30	56
33	Airports/	440
34	(airport* or travel* or border or arena).mp.	135824
35	33 or 34	135824
36	3 and 35	4010
37	limit 36 to english language	3780
38	limit 37 to yr="2010 - 2015"	1079
39	13 and 38	110

40	22 and 38	259
41	Workplace/ or Return to Work/ or exp Personnel, Hospital/	113421
42	(healthcare worker* or "health care worker*" or HCW* or medical staff).mp.	57720
43	41 or 42	145836
44	3 and 43	4138
45	limit 44 to english language	3802
46	limit 45 to yr="2010 - 2015"	1061
47	13 and 46	175
48	22 and 46	201
49	(symptom adj3 screening).mp.	615
50	(symptomatic adj3 screen*).mp.	509
51	(asymptomatic adj3 screen).mp.	241
52	49 or 50 or 51	1353
53	7 and 52	374
54	limit 53 to english language	359
55	limit 54 to yr="2010 - 2015"	90
56	(fit* adj2 work).mp.	938
57	3 and 56	46
58	limit 57 to english language	36
59	limit 58 to yr="2010 - 2015"	7

PubMed

#	Searches	Results
1	"mass screening"[MeSH Terms] OR "screen*"[Title/Abstract]	784597
2	"workplace"[MeSH Terms] OR "return to work"[MeSH Terms] OR "personnel, hospital"[MeSH Terms] OR "health facilities"[MeSH Terms] OR work*[Title/Abstract] OR employe*[Title/Abstract] OR staff*[Title/Abstract] OR healthcare worker*[Title/Abstract] OR "health care worker*"[Title/Abstract] OR HCW[Title/Abstract] OR hospital*[Title/Abstract]	3498697
3	1 and 2	138192
4	limit 3 to english language	128515
5	limit 4 to yr="2010 - 2015"	37933
6	"pandemics"[MeSH Terms] OR "disease outbreaks"[MeSH Terms] OR "disease transmission, infectious"[MeSH Terms] OR "infection control"[MeSH Terms] OR "communicable diseases"[MeSH Terms] OR "transmit*"[Title/Abstract] OR "transmiss*"[Title/Abstract] OR "infectivity"[Title/Abstract] OR "infectiousness"[Title/Abstract] OR "communicable disease*"[Title/Abstract] OR "pandemic*"[Title/Abstract]	753666
7	5 and 6	2454
8	questionnaire*[Title/Abstract] OR assess*[Title/Abstract] OR self-assess*[Title/Abstract] OR "point of care testing"[Title/Abstract] OR "point-of-care testing"[Title/Abstract]	3213850
9	7 and 8	716
10	limit 9 to "review articles"	45
11	"severe acute respiratory syndrome"[MeSH Terms] OR "sars virus"[MeSH Terms] OR "middle east respiratory syndrome coronavirus"[MeSH Terms] OR "influenza a virus, h1n1 subtype"[MeSH Terms] OR "tuberculosis"[MeSH Terms] OR "SARS"[Title/Abstract] OR "MERS"[Title/Abstract] OR "SARS-Cov"[Title/Abstract] OR "MERS-Cov"[Title/Abstract] OR "H1N1"[Title/Abstract] OR "TB"[Title/Abstract] OR "influenza"[Title/Abstract] OR "respiratory"[Title/Abstract]	735398
12	5 and 11	1738
13	8 and 12	605
14	limit 13 to "review articles"	73
15	symptom*[Title/Abstract] OR symptomatic[Title/Abstract] OR asymptomatic[Title/Abstract]	488206

16	7 and 15	187
17	12 and 15	145
18	“visitor*”[Title/Abstract]	10306
19	1 and 18	588
20	limit 19 to english language	554
21	limit 20 to yr="2010 - 2020"	234
22	"airports"[MeSH Terms] OR "airport*"[Title/Abstract] OR "travel*"[Title/Abstract] OR "border"[Title/Abstract] OR "arena"[Title/Abstract]	126375
23	1 and 22	3868
24	limit 23 to english language	3676
25	limit 24 to yr="2010 - 2015"	1077
26	6 and 25	217
27	11 and 25	97
28	"workplace"[MeSH Terms] OR "return to work"[MeSH Terms] OR "personnel, hospital"[MeSH Terms] OR healthcare worker*[Title/Abstract] OR "health care worker*"[Title/Abstract] OR HCW[Title/Abstract] OR "medical staff"[Title/Abstract]	143291
29	1 and 28	4377
30	limit 29 to english language	4032
31	limit 30 to yr="2010 - 2015"	1120
32	6 and 31	194
33	11 and 31	177
34	symptom screening[Title/Abstract] OR symptomatic screen*[Title/Abstract] OR asymptomatic screen*[Title/Abstract]	522
35	2 and 34	164
36	limit 35 to english language	157
37	limit 36 to yr="2010 - 2015"	49
38	"fit for work"[Title/Abstract] OR "fit to work"[Title/Abstract] OR "fitness for work"[Title/Abstract] OR "fitness to work"[Title/Abstract] OR "return to work"[Title/Abstract]	9552
39	1 and 32	347
40	limit 39 to english language	324
35	limit 34 to yr="2010 - 2015"	87

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(screening) AND (airports* OR travel* OR border* OR arena) AND (pandemic OR outbreak OR infectious OR “communicable disease” OR transmission OR SARS OR MERS OR H1N1 OR influenza OR tuberculosis) from:2010 to:2015

(screening) AND(pandemic OR outbreak OR infectious OR “communicable disease” OR transmission OR SARS OR MERS OR H1N1 OR influenza OR tuberculosis) AND (“health care worker” OR healthcare work* OR HCW* OR medical staff*) from:2010 to:2015

("symptom screening" OR "symptomatic screening" OR "asymptomatic screening") AND(pandemic OR outbreak OR infectious OR “communicable disease” OR transmission OR SARS OR MERS OR H1N1 OR influenza OR tuberculosis) AND (“health care worker” OR healthcare work* OR HCW* OR medical staff*) from:2010 to:2015

Reference List

Abbasi, J. (2020). The promise and peril of antibody testing for COVID-19. *Jama*, *323*(19), 1881-1883. Retrieved from: https://jamanetwork-com.ahs.idm.oclc.org/journals/jama/article-abstract/2764954

Amer, H., Alqahtani, A. S., Alaklobi, F., Altayeb, J., & Memish, Z. A. (2018). Healthcare worker exposure to middle east respiratory syndrome coronavirus (MERS-CoV): Revision of screening strategies urgently needed. International Journal of Infectious Diseases, 71, 113-116. doi: https://dx.doi.org/10.1016/j.ijid.2018.04.001

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/

CADTH. (2020). Mass Thermography Screening for Infection and Prevention: A Review of the Clinical Effectiveness. Retrieved from: https://www.cadth.ca/media/pdf/htis/nov-2014/RC0609%20Screening%20Final.pdf. Accessed 3 June 2020.

Center for Evidence-Based Practice. (2020). COVID-19: Temperature Screening for Healthcare Personnel. Retrieved from: http://www.uphs.upenn.edu/cep/COVID/Temperature%20Screening%20421.pdf. Accessed 3 June 2020.

Centers for Disease Control and Prevention. (2020). Operational Considerations for the Identification of Healthcare Workers and Inpatients with Suspected COVID-19 in non-US Healthcare Settings. Retrieved from: https://www.cdc.gov/coronavirus/2019-ncov/hcp/non-us-settings/guidance-identify-hcw-patients.html. Accessed 3 June 2020.

Cheng, S., Tollefson, D., He, G., Li, Y., Guo, H., Chai, S., . . . Rao, C. Y. (2018). Evaluating a framework for tuberculosis screening among healthcare workers in clinical settings, inner Mongolia, China. Journal of Occupational Medicine & Toxicology, 13, 11. doi: https://dx.doi.org/10.1186/s12995-018-0192-y

Cho, K. S., & Yoon, J. (2014). Fever screening and detection of febrile arrivals at an international airport in Korea: Association among self-reported fever, infrared thermal camera scanning, and tympanic temperature. Epidemiology and Health, 36 Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4101989/

Chow, E. J., Schwartz, N. G., Tobolowsky, F. A., Zacks, R. L. T., Huntington-Frazier, M., Reddy, S. C., & Rao, A. K. (2020). Symptom screening at illness onset of health care personnel with SARS-CoV-2 infection in King County, Washington. Jama, 323(20), 2087-2089. doi:10.1001/jama.2020.6637 Retrieved from https://jamanetwork.com/journals/jama/fullarticle/2764953

Clifford, S., Pearson, C. A., Klepac, P., Van Zandvoort, K., Quilty, B. J., Eggo, R., . . . CMMID COVID-19 working group. (2020). Effectiveness of interventions targeting air travellers for delaying local outbreaks of SARS-CoV-2. Retrieved from https://academic.oup.com/jtm/advance-article/doi/10.1093/jtm/taaa068/5834629

Cowling, B. J., Lau, L. L. H., Wu, P., Wong, H. W. C., Fang, V. J., Riley, S., & Nishiura, H. (2010). Entry screening to delay local transmission of 2009 pandemic influenza A (H1N1). BMC Infectious Diseases, 10, 82. doi: https://dx.doi.org/10.1186/1471-2334-10-82

del Campo, M. T., Fouad, H., Solis-Bravo, M. M., Sanchez-Uriz, M. A., Mahillo-Fernandez, I., & Esteban, J. (2012). Cost-effectiveness of different screening strategies (single or dual) for the diagnosis of tuberculosis infection in healthcare workers. Infection Control & Hospital Epidemiology, 33(12), 1226-1234. doi: https://dx.doi.org/10.1086/668436

ECRI. (2020). Infrared Temperature Screening to Identify Potentially Infected Staff or Visitors Presenting to Healthcare Facilities during Infectious Disease Outbreaks. Retrieved from: https://assets.ecri.org/PDF/COVID-19-Resource-Center/COVID-19-Clinical-Care/COVID-ECRI-Temperature-Screening.pdf. Accessed 3 June 2020.

Evans, S., Agnew, E., Vynnycky, E., & Robotham, J. V. (2020). The impact of testing and infection prevention and control strategies on within-hospital transmission dynamics of COVID-19 in English hospitals. *medRxiv*. Retrieved from: https://www.medrxiv.org/content/10.1101/2020.05.12.20095562v2.full.pdf

Foster-Chang, S. A., Manning, M. L., & Chandler, L. (2014). Tuberculosis screening of new hospital employees: Compliance, clearance to work time, and cost using tuberculin skin test and interferon-gamma release assays. Workplace Health & Safety, 62(11), 460-467. doi: https://dx.doi.org/10.3928/21650799-20140902-02

Galan, I., Velasco, M., Casas, M. L., Goyanes, M. J., Rodriguez-Caravaca, G., Losa, J. E., ... & Castilla, V. (2020). SARS-cov-2 seroprevalence among all workers in a teaching hospital in Spain: unmasking the risk. *medRxiv*. Retrieved from: https://www.medrxiv.org/content/10.1101/2020.05.29.20116731v1.full.pdf.

Giri, P., Basu, S., Sargeant, T., Rimmer, A., Pirzada, O., & Adisesh, A. (2014). Pre-placement screening for tuberculosis in healthcare workers. Occupational Medicine (Oxford), 64(7), 524-529. doi: https://dx.doi.org/10.1093/occmed/kqu107

Gold, L., Balal, E., Horak, T., Cheu, R. L., Mehmetoglu, T., & Gurbuz, O. (2019). Health screening strategies for international air travelers during an epidemic or pandemic. Journal of Air Transport Management, 75, 27-38. doi:10.1016/j.jairtraman.2018.11.006 Retrieved from http://www.sciencedirect.com/science/article/pii/S0969699718300632

Gostic, K. M., Kucharski, A. J., & Lloyd-Smith, J. O. (2015). Effectiveness of traveller screening for emerging pathogens is shaped by epidemiology and natural history of infection. Elife, 4, e05564. Retrieved from https://cdn.elifesciences.org/articles/05564/elife-05564-v1.pdf

Gostic, K., Gomez, A. C., Mummah, R. O., Kucharski, A. J., & Lloyd-Smith, J. O. (2020a). Estimated effectiveness of symptom and risk screening to prevent the spread of COVID-19. eLife, 9 doi:10.7554/eLife.55570 Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7060038/

Gunaratnam, P. J., Tobin, S., Seale, H., Marich, A., & McAnulty, J. (2014). Airport arrivals screening during pandemic (H1N1) 2009 influenza in New South Wales, Australia. Medical Journal of Australia, 200(5), 290-292. doi:10.5694/mja13.10832

Hale, M. J., Hoskins, R. S., & Baker, M. G. (2012). Screening for influenza A(H1N1)pdm09, auckland international airport, New Zealand. Emerging Infectious Diseases, 18(5), 866-868. doi: https://dx.doi.org/10.3201/eid1805.111080

Hogan, D.E., Shipman, S., Smith, K. (2015). Simple infrared thermometry in fever detection: Consideration in mass fever screening. American Journal of Disaster Medicine, 10(1), 69-74. doi:10.5055/ajdm.2015.0190 Retrieved from https://www.wmpllc.org/ojs/index.php/ajdm/article/view/214

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

Huizer, Y. L., Swaan, C. M., Leitmeyer, K. C., & Timen, A. (2015). Usefulness and applicability of infectious disease control measures in air travel: A review. Travel Medicine & Infectious Disease, 13(1), 19-30. doi: https://dx.doi.org/10.1016/j.tmaid.2014.11.008

Hunter, E., Price, D. A., Murphy, E., van der Loeff, Ina Schim, Baker, K. F., Lendrem, D., . . . Welch, A. (2020). First experience of COVID-19 screening of health-care workers in England. The Lancet, 395(10234), e77-e78. Retrieved from https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(20)30970-3/fulltext?fbclid=IwAR1-kd1dgLMQYGB_y4dbDr-7GamwTdh1xgdXTOb4odBLCxxtxkgjCVsyves

Ismael, C., Silva, Pedro Alexandre Ismael Amaral, da Silva, C. M., de Melo, Mauro Sergio Vieira, Neto, B. A. F., de Melo, J. V., . . . Domenge, C. Universal screening of SARS-CoV-2 of oncology healthcare workers—a Brazilian experience. *Scielo.* Preprint. Retrieved from https://scholar.google.ca/scholar?hl=en&as_sdt=0%2C5&q=Universal+Screening+of+SARS-CoV-2+of+Oncology+Healthcare+Workers%E2%80%94a+Brazilian+experience&btnG=

Janagond, A. B., Ganesan, V., Vijay Kumar, G. S., Ramesh, A., Anand, P., & Mariappan, M. (2017). Screening of health-care workers for latent tuberculosis infection in a tertiary care hospital. International Journal of Mycobacteriology, 6(3), 253-257. doi: https://dx.doi.org/10.4103/ijmy.ijmy_82_17

Jennings, L. C., Priest, P. C., Psutka, R. A., Duncan, A. R., Anderson, T., Mahagamasekera, P., . . . Baker, M. G. (2015). Respiratory viruses in airline travellers with influenza symptoms: Results of an airport screening study. Journal of Clinical Virology, 67, 8-13. doi: https://dx.doi.org/10.1016/j.jcv.2015.03.011

Khalil, A., Hill, R., Ladhani, S., Pattisson, K., & O'Brien, P. (2020). COVID-19 screening of health-care workers in a London maternity hospital. The Lancet Infectious Diseases, Retrieved from https://www.thelancet.com/journals/laninf/article/PIIS1473-3099(20)30403-5/fulltext

Ledda, C., Cina, D., Garozzo, S. F., Senia, P., Consoli, A., Marconi, A., . . . Rapisarda, V. (2019). Tuberculosis screening among healthcare workers in Sicily, Italy. Future Microbiology, 14, 37-40. doi: https://dx.doi.org/10.2217/fmb-2018-0265

Linam, W. M., Marrero, E. M., Honeycutt, M. D., Wisdom, C. M., Gaspar, A., & Vijayan, V. (2019). Focusing on families and visitors reduces healthcare associated respiratory viral infections in a neonatal intensive care unit. Pediatric Quality & Safety, 4(6), e242. doi: https://dx.doi.org/10.1097/pq9.0000000000000242

Memish, Z. A., Al-Tawfiq, J. A., Makhdoom, H. Q., Al-Rabeeah, A. A., Assiri, A., Alhakeem, R. F., . . . Zumla, A. (2014). Screening for middle east respiratory syndrome coronavirus infection in hospital patients and their healthcare worker and family contacts: A prospective descriptive study. Clinical Microbiology & Infection, 20(5), 469-474. doi: https://dx.doi.org/10.1111/1469-0691.12562

Mermel, L. A., Jefferson, J. A., Smit, M. A., & Auld, D. B. (2019). Prevention of hospital-acquired respiratory viral infections: Assessment of a multimodal intervention program. Infection Control & Hospital Epidemiology, 40(3), 362-364. doi: https://dx.doi.org/10.1017/ice.2018.337

Moucaut, A., Nienhaus, A., Courtois, B., Nael, V., Longuenesse, C., Ripault, B., . . . Tripodi, D. (2013). The effect of introducing IGRA to screen French healthcare workers for tuberculosis and potential conclusions for the work organisation. Journal of Occupational Medicine & Toxicology, 8, 12. doi: https://dx.doi.org/10.1186/1745-6673-8-12

Mouchtouri, V. A., Christoforidou, E. P., An der Heiden, M., Menel Lemos, C., Fanos, M., Rexroth, U., . . . Hadjichristodoulou, C. (2019). Exit and entry screening practices for infectious diseases among travelers at points of entry: Looking for evidence on public health impact. International Journal of Environmental Research & Public Health [Electronic Resource], 16(23), 11 21. doi: https://dx.doi.org/10.3390/ijerph16234638

Napoli, C., Ferretti, F., Di Ninno, F., Orioli, R., Marani, A., Sarlo, M. G., . . . Orsi, G. B. (2017). Screening for tuberculosis in health care workers: Experience in an Italian teaching hospital. BioMed Research International, 2017, 7538037. doi: https://dx.doi.org/10.1155/2017/7538037

Nishiura, H., & Kamiya, K. (2011). Fever screening during the influenza (H1N1-2009) pandemic at Narita international airport, Japan. BMC Infectious Diseases, 11(1), 111. Retrieved from https://link.springer.com/article/10.1186/1471-2334-11-111

Olalla, J., Correa, A. M., Martin-Escalante, M. D., Hortas, M. L., Martin-Sendarrubias, M. J., Fuentes, V., . . . ROBLE Group. (2020). Search for asymptomatic carriers of SARS-CoV-2 in healthcare workers during the pandemic: A Spanish experience. medRxiv, Retrieved from https://www.medrxiv.org/content/medrxiv/early/2020/05/20/2020.05.18.20103283.full.pdf

Park, G. E., Ko, J., Peck, K. R., Lee, J. Y., Lee, J. Y., Cho, S. Y., . . . Kim, Y. (2016). Control of an outbreak of middle east respiratory syndrome in a tertiary hospital in Korea. Annals of Internal Medicine, 165(2), 87-93. Retrieved from https://www.acpjournals.org/doi/full/10.7326/M15-2495

Png, M. E., Yoong, J., Ong, C. W. M., Fisher, D., & Bagdasarian, N. (2019). A screening strategy for latent tuberculosis in healthcare workers: Cost-effectiveness and budget impact of universal versus targeted screening. Infection Control & Hospital Epidemiology, 40(3), 341-349. doi: https://dx.doi.org/10.1017/ice.2018.334

Priest, P. C., Jennings, L. C., Duncan, A. R., Brunton, C. R., & Baker, M. G. (2015). Effectiveness of border screening for detecting influenza in arriving airline travelers. American Journal of Public Health, 105(Suppl 4), 607. doi: https://dx.doi.org/10.2105/AJPH.2012.300761r

Quilty, B. J., Clifford, S., Flasche, S., & Eggo, R. M. (2020). Effectiveness of airport screening at detecting travellers infected with novel coronavirus (2019-nCoV). Eurosurveillance, 25(5) doi:10.2807/1560-7917.ES.2020.25.5.2000080 Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7014668/

Rivett, L., Sridhar, S., Sparkes, D., Routledge, M., Jones, N. K., Forrest, S., . . . Ferris, M. (2020). Screening of healthcare workers for SARS-CoV-2 highlights the role of asymptomatic carriage in COVID-19 transmission. Elife, 9, e58728. Retrieved from https://elifesciences.org/articles/58728.pdf

Sandri, M. T., Azzolini, E., Torri, V., Carloni, S., Tedeschi, M., Castoldi, M., ... & Rescigno, M. (2020). IgG serology in health care and administrative staff populations from 7 hospital representative of different exposures to SARS-CoV-2 in Lombardy, Italy. *medRxiv*. Retrieved from: https://www.medrxiv.org/content/10.1101/2020.05.24.20111245v1.full.pdf

Sun, G., Nakayama, Y., Dagdanpurev, S., Abe, S., Nishimura, H., Kirimoto, T., & Matsui, T. (2017). Remote sensing of multiple vital signs using a CMOS camera-equipped infrared thermography system and its clinical application in rapidly screening patients with suspected infectious diseases. International Journal of Infectious Diseases, 55, 113-117.

Torres Costa, J., Silva, R., Ringshausen, F. C., & Nienhaus, A. (2011). Screening for tuberculosis and prediction of disease in Portuguese healthcare workers. Journal of Occupational Medicine & Toxicology, 6, 19. doi: https://dx.doi.org/10.1186/1745-6673-6-19

Tostmann, A., Bradley, J., Bousema, T., Yiek, W., Holwerda, M., Bleeker-Rovers, C., . . . Wertheim, H. (2020). Strong associations and moderate predictive value of early symptoms for SARS-CoV-2 test positivity among healthcare workers, the Netherlands, March 2020. Euro Surveillance: Bulletin Europeen Sur Les Maladies Transmissibles = European Communicable Disease Bulletin, 25(16), 04. doi: https://dx.doi.org/10.2807/1560-7917.ES.2020.25.16.2000508

Treibel, T. A., Manisty, C., Burton, M., McKnight, Á, Lambourne, J., Augusto, J. B., . . . Moon, J. C. (2020). COVID-19: PCR screening of asymptomatic health-care workers at London hospital. The Lancet, Retrieved from https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(20)31100-4/fulltext?ref=theprepping-com

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/

Vinkeles Melchers, Natalie V S., van Elsland, S. L., Lange, J. M. A., Borgdorff, M. W., & van den Hombergh, J. (2013). State of affairs of tuberculosis in prison facilities: A systematic review of screening practices and recommendations for best TB control. PLoS ONE [Electronic Resource], 8(1), e53644. doi: https://dx.doi.org/10.1371/journal.pone.0053644

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/

Weitz, J. S., Beckett, S. J., Coenen, A. R., Demory, D., Dominguez-Mirazo, M., Dushoff, J., ... & Rodriguez-Gonzalez, R. (2020). Modeling shield immunity to reduce COVID-19 epidemic spread. *Nature medicine*, 1-6. Retrieved from: https://www.nature.com/articles/s41591-020-0895-3.

WorkSafe BC. (2020). Efficacy and/or Effectiveness of COVID-19 Temperature Screening of Workers. Retrieved from: https://www.worksafebc.com/en/resources/health-care-providers/guides/efficacy-effectiveness-covid-19-temperature-screening-workers?lang=en. Accessed 3 June 2020.

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

Yombi, J. C., De Greef, J., Marsin, A., Simon, A., Rodriguez-Villalobos, H., Penaloza, A., & Belkhir, L. (2020). Symptom-based screening for COVID-19 in health care workers: The importance of fever. The Journal of Hospital Infection, doi:10.1016/j.jhin.2020.05.028 Retrieved from https://www.journalofhospitalinfection.com/article/S0195-6701(20)30259-0/pdf