Rapid Review Report

Review Title:	**What is the sensitivity and specificity of screening checklists and temperature checks for detecting the presence of COVID-19 in individuals?**
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Key Findings

- Screening tools commonly include fever, respiratory symptoms (cough, shortness of breath), and epidemiological risk factors.
- The sensitivity and specificity of screening questionnaires depends considerably on the items used in the questionnaire. The limited published literature demonstrates great variability in the performance of different screening tools: sensitivity ranges from 0 – 48.6 – 84.3 – 100%; specificity ranges from 64.8 – 71.3 – 89.6 – 96%).
- The standard WHO symptom checklist performs poorly, with a sensitivity of 48.6%, and specificity of 89.6%. As such, half of individuals who have SARS-CoV-2 present at the time of testing will be missed by the symptom questionnaire (being either asymptomatic or presymptomatic). Depending on the population being screened the prevalence of the virus may vary widely.

Given the sensitivity and specificity of the WHO symptom checklist in a population with prevalence ranging from 0.1% to 1% to 10% the positive predictive value (PPV) will be poor, range from 0.4% to 4.8% to 35%, respectively. Furthermore, the performance characteristics of the screening questionnaire may be poorer than reported if used in a setting or time of year when other respiratory viruses with similar symptoms are circulating.

Limitations

- There is limited evidence available assessing the sensitivity and specificity of screening tools
- Consensus is needed on which items should form part of a screening tool

GRADE of Evidence: B - Moderate

A grade of "B" is assigned when further research is likely to have an important impact on confidence in the estimate of effect and may change the estimate. The review may include one high quality study and/or several studies with some limitations.

For more information about how this rating was determined, visit https://www.essentialevidenceplus.com/product/ebm_loe.cfm?show=grade

Background/Context

Effective screening for Corona Virus Disease 2019 (COVID-19) is important to limit the epidemic. Due to limitations in testing capacity and false-negative tests due to low viral load in some samples, positive cases may not be detected. There is therefore a need to identify symptom combinations that might indicate the presence of the virus. However, the sensitivity and specificity of symptom checklists and temperature screening to accurately detect COVID-19 is unclear.

Purpose

To inform the development of non-invasive screening tools to be used to identify health care workers (HCW), patients and visitors to hospitals and long-term care (LTC) facilities who may have COVID-19.

Review Question

- What is the sensitivity and specificity of screening checklists and temperature checks for detecting the presence of COVID-19 in individuals?

Method

A rapid review was conducted to address the review question. Rapid reviews aim to produce a summary of evidence in a short space of time by modifying methodological elements of a systematic review. A literature search was conducted by a librarian and reviewed and synthesised by a research facilitator in less than 5 days. The search included both peer-reviewed and grey literature (see Appendix). The rating of the quality of evidence provided on the first page used the GRADE system.

Summary of Evidence

Twelve studies, with varying degrees of relevance, were included in this analysis. Eight were related to COVID-19 and four were related to previous outbreaks of SARS and MERS. Three were review articles and two used simulation modelling. There was very limited direct evidence of sensitivity and specificity of screening checklists.

A hospital in Singapore measured the sensitivity and specificity of their 'internal screening criteria' as well as that of WHO's 'official screening criteria' [1]. The official case screening criteria comprised fever, cough, shortness of breath, epidemiological risk factors of travel to an area with local transmission or contact with confirmed cases of COVID-19. Their 'internal screening criteria' included additional factors: anosmia; high risk occupation; travel to Southeast Asian and European countries; close contact with recent travelers or with an 'unwell' contact of a COVID-19 positive patient. The internal screening criteria had 84.3% sensitivity (95% confidence interval, CI=73.6% to 91.9%), with a specificity of 64.8% (95% CI=62.5% to 67.0%), whereas the sensitivity of the official screening criteria was 48.6% (95% CI=36.4% to 60.8%), with a specificity of 89.6% (95%CI=88.1% to 91.0%) [1]. A further study showed that screening of children using the criteria of: fever or respiratory symptoms and a positive epidemiological history (travel to Wuhan, China, contact with confirmed COVID-19 case, contact with suspect case, or part of a cluster investigation) had 100% sensitivity and 71.3% specificity [5].

Conversely, symptom-based screening of fever, fatigue, sore throat, cough, runny nose, muscle aches, diarrhea, and signs of infection in the nose and throat was found to be ineffective in repatriated German nationals (sensitivity of 0% and specificity of 96%) [2]. Screening using fever alone has been shown to be ineffective for both COVID-19 [6, 7] and other infectious diseases [12, 13]. Simulation modelling estimated that screening of travelers is ineffective as many are pre-symptomatic or unwilling to report symptoms [8, 9].

Two teams have created diagnostic models using multivariate logistic regression analyses. The first included signs of pneumonia on CT, meaningful respiratory symptoms, history of close contact, fever, neutrophil-to-lymphocyte ratio (NLR), maximum temperature, age, and sex as predictors of infection [3]. The second found loss of taste and smell to be a strong predictor of infection, together with the established symptoms of fever and continuous cough. The authors suggested that the combination of symptoms that could be used to identify and isolate individuals includes anosmia, fever, persistent cough, diarrhea, fatigue, abdominal pain and loss of appetite [4]. Probability of disease of disease could be calculated using these models, but not the sensitivity or specificity of the screening criteria.

During the SARS outbreak, criteria of fever, dyspnea, diarrhea, travel, close contact, hospital exposure, and household history, as well as assessment of white blood cell count and CXR resulted in sensitivity and specificity of 95.5% and 87.2% respectively [11].

Common clinical features of COVID-19 to date are fever, fatigue, dry cough, anorexia, myalgia, dyspnea, and sputum production. Other features include smell and taste disorders (e.g., anosmia and dysgeusia) gastrointestinal symptoms (e.g., nausea and diarrhea), headache, sore throat, and rhinorrhea, and conjunctivitis. Rarer symptoms include urticarial eruptions and transient livedo reticularis. There are anecdotal descriptions of reddish-purple nodules on the distal digits similar to pernio (chilblains) in children and young adults with suspected COVID-19, although there is no clear association [7].

The Ontario Ministry of Health recommends testing in the case of fever; OR any new/worsening symptom including cough, shortness of breath (dyspnea), sore throat, runny nose or sneezing, nasal congestion, hoarse voice, difficulty swallowing, new olfactory or taste disorder(s), nausea/vomiting, diarrhea, abdominal pain); OR clinical or radiological evidence of pneumonia [14]. It is unknown whether these criteria are supported through sensitivity and specificity testing.

Conclusions

Screening tools commonly include fever, respiratory symptoms (cough, shortness of breath), and epidemiological risk factors. The addition of anosmia may be helpful [1, 4]. The sensitivity and specificity of screening questionnaires depends considerably on the items used in the questionnaire. The limited moderate quality published literature demonstrates great variability in the performance of different screening tools: sensitivity ranges from 0 – 48.6 – 84.3 – 100%; specificity ranges from 64.8 – 71.3 – 89.6 – 96%).

The standard WHO symptom checklist performs poorly, with a sensitivity of 48.6%, and specificity of 89.6%. As such, half of individuals who have SARS-CoV-2 present at the time of testing will be missed by the symptom questionnaire, being either asymptomatic or presymptomatic. Depending on the population being screened the prevalence of the virus may vary widely. Given the sensitivity and specificity of the WHO symptom checklist in a population with prevalence ranging from 0.1% to 1% to 10% the positive predictive value (PPV) will be poor, range from 0.4% to 4.8% to 35%, respectively. Furthermore, the performance characteristics of the screening questionnaire may be poorer than reported if used in a setting or time of year when other respiratory viruses with similar symptoms are circulating.

Glossary

Sensitivity: The ability of the test to detect disease when present (positivity in the presence of disease).

Specificity: The ability of the test to detect only the disease sought (negativity in the absence of disease).

Table 1: Summary of Literature

Ref	Study Type / Sample/ population	Method	Sensitivity and specificity of screening checklists	Additional findings / Conclusions	Quality of study
Covid-19 Specific Studies					
1.	Descriptive. 1,841 cases requiring hospital admission.	To evaluate case detection at ED triage, the sensitivity and specificity of our internal screening criteria in detecting COVID-19 was calculated and compared to the official case criteria. Patients were tested for COVID-19 via rtPCR of respiratory samples for SARSCoV-2. A confirmed case of COVID-19 was defined as a positive test for SARS-CoV-2 via rtPCR testing, while patients were considered negative for COVID-19 at the point of testing if they had 2 negative COVID-19 samples taken 24 hours apart.	*Official case criteria*: fever, respiratory syndrome, epidemiological risk factors of travel to an area with local transmission or contact with infected persons. *Internal ED screening criteria*: Undifferentiated fever; respiratory syndromes (Pneumonia or ARD of any severity); anosmia; epidemiological risk factors, including higher risk occupation, travel to Southeast Asian and European countries, contact with recent travellers, and contact with infected persons. The internal criteria had 84.3% sensitivity (95% confidence interval, CI=73.6% to 91.9%), with a specificity of 64.8% (95% CI=62.5% to 67.0%), whereas the sensitivity of the official screening criteria was 48.6% (95% CI=36.4% to 60.8%), with a specificity of 89.6% (95%CI=88.1% to 91.0%). Of the 11 cases that did not fulfil either official or internal screening criteria, all were locally transmitted cases that did not have history of travel and did not have links with a confirmed COVID-19 case or cluster.	While using a case definition based on travel history and contact with confirmed cases of COVID-19 is possible in the early phases of an outbreak when cases are mostly imported, during ongoing community transmission, distinguishing between cases of COVID-19 and ordinary pneumonia becomes difficult. Fever, though common, may not occur in all patients with COVID-19 on initial presentation, and individuals may not present with severe respiratory disease. While official case criteria were fairly sensitive, more than half of confirmed COVID-19 cases did not fulfil the official case definitions.	Moderate
2.	Descriptive. 126 German nationals repatriated from Hubei	Screening for symptoms and clinical signs of infection was performed before their departure from China.	Two passengers had had contact with 1 person who had a confirmed case of SARS-CoV-2 infection, 6 had reported symptoms, were deemed to be clinically symptomatic, or both, and 2 passengers had accompanied family	A symptom-based screening process was ineffective in detecting SARS-CoV-2 infection in 2 persons who later were found to have evidence of SARS-CoV-2	Moderate

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	province		members who had been isolated on the flight because of suspected SARS-CoV-2 infection or because of other symptoms (i.e., symptoms related to pregnancy). All 10 tested negative for SARS-CoV-2 by real-time reverse-transcription–polymerase-chain-reaction (RT-PCR) assays4 of throat swabs and sputum. The remaining 116 passengers were evaluated by a medical team of physicians. Each passenger was asked to report current symptoms of fever, fatigue, sore throat, cough, runny nose, muscle aches, and diarrhea, and each one was screened for signs of infection in the nose and throat. The temperature of all passengers was taken. All were afebrile except for 1 passenger who had a temperature of 38.4°C and reported dyspnea and cough. However, testing to detect SARS-CoV-2 by RT-PCR of a throat swab and sputum was negative. Two of the 114 persons (1.8%) in this cohort of travelers who had passed the symptoms-based screening tested positive for SARS-CoV-2 by RT-PCR (cycle threshold value in the two samples, 24.39 and 30.25, respectively).	in a throat swab. We discovered that shedding of potentially infectious virus may occur in persons who have no fever and no signs or only minor signs of infection.	
3.	Development of diagnostic model. 1,311 COVID-19 positive patients	Multivariate logistic regression analyses were performed to construct the diagnostic model. Receiver operating characteristic (ROC) curve analysis were used for model validation.	Signs of pneumonia on CT, meaningful respiratory symptoms, history of close contact, fever, neutrophil-to-lymphocyte ratio (NLR), Tmax, age, and sex were included in the diagnostic model. We converted the diagnostic model into a scoring tool by assigning values to	A further study to validate and optimize the model is required.	Moderate

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			each variable in the equation. Because of incomplete information, such as smoking history and basic diseases, we cannot conduct a comprehensive analysis of these factors.		
4.	Community survey. Subscribers of RADAR COVID-19, an app that was launched for use among the UK general population asking about COVID-19 symptoms	1,573,103 individuals reported their symptoms via the app; 26% reported suffering from one or more symptoms of COVID-19. Of those, n=1702 reported having had a RT-PCR COVID-19 test and gave full report on symptoms including loss of smell and taste; 579 were positive and 1123 negative. Multivariate logistic regression adjusting for age, sex and BMI was applied to investigate the correlation between loss of taste and smell and COVID-19 in 579 cases and 1123 controls from participants of the RADAR COVID app who were also tested in the lab for COVID-19. In this same dataset, we then performed stepwise logistic regression combining forward and backward algorithms, to identify other symptoms associated to COVID-19 independently of loss of smell and taste. We included in the model ten other symptoms (including fever, persistent cough, fatigue, shortness of breath, diarrhoea, delirium, skipped meals, abdominal pain, chest pain and	Loss of smell and taste were present in 59% of COVID-19 positive individuals compared to 18% of those negative to the test, yielding an odds ratio (OR) of COVID-19 diagnosis of OR[95%CI]=6.59[5.25; 8.27], P= 1.90x10-59 . We also find that a combination of loss of smell and taste, fever, persistent cough, fatigue, diarrhoea, abdominal pain and loss of appetite is predictive of COVID-19 positive test with sensitivity 0.54[0.44; 0.63], specificity 0.86[0.80; 0.90], ROC-AUC 0.77[0.72; 0.82] in the test set, and cross-validation ROC-AUC 0.75[0.72; 0.77]. In this model, the strongest predictor was loss of smell and taste. We also computed the ROC-AUC stratifying for sex and age-groups and found that results were similar in all groups with no significant differences between strata suggesting that our model works in the same way within different sex and age-groups. Finally, we applied the predictive model to the 410,598 individuals reporting symptoms who had not had a COVID-19 test and we find that according to our model 13.06% [12.97%;13.15%] of individuals reporting some COVID-19 symptoms are likely to be infected by the virus.	Loss of taste and smell is a strong predictor of having been infected by the COVID-19 virus besides the most established symptoms of having a high temperature and a new, continuous cough. The combination of symptoms that could be used to identify and isolate individuals includes anosmia, fever, persistent cough, diarrhoea, fatigue, abdominal pain and loss of appetite.	Moderate

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		hoarse voice) as well as age and sex and chose, as the best model, the one with the lowest AIC.			
5.	Develop procedure to identify cases in children. Sample of 56 cases	Rapid screening algorithm: collect medical history, conduct physical examination, order protected bedside chest radiography, collect specimens (blood routine and nasopharyngeal swabs). Epidemiological history includes (I) history of travel or residence in either Wuhan City and surrounding areas, or communities with confirmed COVID-19 cases within 14 days before the onset of symptoms; (II) direct person-to-person contact with confirmed COVID-19 infected person (positive nucleic acid test) within 14 days before the onset of symptoms; (III) direct person-to-person contact with the patient with presenting symptoms of fever or respiratory infection from either Wuhan City and surrounding areas within 14 days before the onset of symptoms; (IV) cluster onset.	Screening: 1) check for fever and/or respiratory symptoms; 2) check epidemiological history. If the patient has both, they are a suspected case. Outcomes: 1) If fever and respiratory symptoms but no epidemiological history, they have a routine diagnosis and treatment. 2) If non-fever but respiratory symptoms and an epidemiological history, they are isolated at home for 2 weeks. 3) If non-fever but respiratory symptoms and no epidemiological history, they have a routine diagnosis and treatment. Our COVID-19 screening procedure identified 124 patients with significant epidemiology. 56 were considered suspected cases, and 10 cases were confirmed as COVID-19.	No patients were missed in the patient's first visit. The sensitivity of this method is 100% and the specificity is 71.3%.	Moderate
6.	Description of 565 people evacuated from Wuhan	All passengers screened for symptoms on arrival using thermoscanners for temperature and interviews for respiratory tract infections. 63 were symptomatic. Second, the passengers were tested for presence of 2019-nCoV using reverse transcription polymerase chain reaction		The main aim of this article was to ascertain under-reporting of cases by the Chinese government and not sensitivity and specificity of screening measures.	Moderate

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		(RT-PCR), and eight passengers (1.4%) were determined to have the virus. Importantly, most of the individuals positive for the virus were asymptomatic (five passengers), while only the other three had symptoms consistent with 2019-nCoV infection.			
7.	Review	**Initial presentation** — Pneumonia appears to be the most frequent serious manifestation of infection, characterized primarily by fever, cough, dyspnea, and bilateral infiltrates on chest imaging [47,64,68,69]. However, other features, including upper respiratory tract symptoms, myalgias, diarrhea, and smell or taste disorders, are also common. There are no specific clinical features that can yet reliably distinguish COVID-19 from other viral respiratory infections, although development of dyspnea several days after the onset of initial symptoms is suggestive. Most studies describing the clinical features of COVID-19 have been performed in hospitalized populations. In a study describing 138 patients hospitalized with COVID-19 pneumonia in Wuhan, the most common clinical features at the onset of illness were [47]: ●Fever in 99 percent ●Fatigue in 70 percent ●Dry cough in 59 percent ●Anorexia in 40 percent ●Myalgias in 35 percent ●Dyspnea in 31 percent ●Sputum production in 27 percent Other cohort studies of patients with confirmed COVID-19 have reported a similar range of clinical findings [47,68,103-105]. However, fever might not be a universal finding on presentation. In one study, fever was reported in almost all patients, but approximately 20 percent had a very low grade fever <100.4°F/38°C [68]. In another study of 1099 patients from Wuhan and other areas in China, fever (defined as an axillary temperature over 99.5°F/37.5°C) was present in only 44 percent on admission but was ultimately noted in 89 percent during the hospitalization [64]. Although not highlighted in the initial cohort studies from China, smell and taste disorders (eg, anosmia and dysgeusia) have also been reported as common symptoms in patients with COVID-19 [106-108]. In a survey of 59 patients with COVID-19 in Italy, 34 percent self-reported either a smell or taste aberration and 19 percent reported both [107]. In a survey of 202 outpatients with mild COVID-19 in Italy, 64 percent reported alterations in smell or taste, and 24 percent reported very severe alterations; smell			Moderate

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		or taste changes were reported as the only symptom in 3 percent overall and preceded symptoms in another 12 percent [109]. Whether this finding is a distinguishing feature of COVID-19 is uncertain. In addition to respiratory symptoms, gastrointestinal symptoms (eg, nausea and diarrhea) have also been reported; and in some patients, they may be the presenting complaint [47,68,105,110]. In a systematic review of studies reporting on gastrointestinal symptoms in patients with confirmed COVID-19, the pooled prevalence was 18 percent overall, with diarrhea, nausea/vomiting, or abdominal pain reported in 13, 10, and 9 percent, respectively [25]. Other reported symptoms have included headache, sore throat, and rhinorrhea [64,69]. Conjunctivitis has also been described [24]. Dermatologic findings in patients with COVID-19 are not well characterized. There have been rare reports of urticarial eruptions and transient livedo reticularis [111,112]. Reddish-purple nodules on the distal digits similar in appearance to pernio (chilblains) have also been anecdotally described in children and young adults with suspected COVID-19, although an association has not been clearly established [113]. The possibility of COVID-19 should be considered primarily in patients with new onset fever and/or respiratory tract symptoms (eg, cough, dyspnea). It should also be considered in patients with severe lower respiratory tract illness without any clear cause. Other consistent symptoms include myalgias, diarrhea, and smell or taste aberrancies. Although these syndromes can occur with other viral respiratory illnesses, the likelihood of COVID-19 is increased if the patient: ●Resides in or has traveled within the prior 14 days to a location where there is community transmission of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2; ie, large numbers of cases that cannot be linked to specific transmission chains); in such locations, residence in congregate settings or association with events where clusters of cases have been reported is a particularly high risk for exposure. **or** ●Has had close contact with a confirmed or suspected case of COVID-19 in the prior 14 days, including through work in health care settings. Close contact includes being within approximately six feet (about two meters) of a patient for a prolonged period of time while not wearing personal protective equipment (PPE) or having direct contact with infectious secretions while not wearing PPE.			
8.	Simulation study modelling	We use a mathematical model to analyse the expected performance of different screening measures for COVID-19, based on what is currently known about its natural history and epidemiology and on different possible combinations of	Upon screening, travellers fall into one of four categories: (1) symptomatic but not aware of exposure risk, (2) aware of exposure risk but without detectable symptoms, (3) symptomatic and aware that exposure may have occurred, and (4) neither symptomatic nor aware of	A fundamental shortcoming of screening is the difficulty of detecting infected individuals during their incubation period, or early after the onset of symptoms, at which point they	Low

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		departure and arrival screening policies.	exposure risk. Travellers in the final category are fundamentally undetectable, and travellers in the second category are only detectable if aware that they have been exposed and willing to self report. Here, we only consider infected travellers who submit to screening. We estimate that screening will detect less than half of infected travellers in a growing epidemic, and that screening effectiveness will increase marginally as growth of the source epidemic decelerates.	still feel healthy enough to undertake normal activities or travel. Our results emphasize that the true fraction of subclinical cases (those who lack fever or cough at symptom onset) remains a crucial unknown, and strongly impacts screening effectiveness. Reviewing data from active surveillance of passengers on cruise ships or repatriation flights, we estimate that up to half of cases show no detectable symptoms at the time of diagnosis. Our analysis underscores the reality that respiratory viruses are difficult to detect by symptom and risk screening programs, particularly if a substantial fraction of infected people show mild or indistinct symptoms, if incubation periods are long, and if transmission is possible before the onset of symptoms.	
9.	Simulation study modelling 100 infected airline passengers	We assume that the time of starting travel is randomly and uniformly distributed between the time of infection and twice the expected time to severe disease, ensuring that simulated	We find that 46 of 100 infected travellers will enter undetected.	It is important to note that our estimates are based on a number of key assumptions that cannot yet be informed directly by evidence from the ongoing 2019-	Low

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		travellers are travelling during their incubation period. However, we only consider those travellers who depart before their symptoms progress to being so severe that they would require hospital care. We simulate travellers with individual incubation period, time from onset to severe disease, flight start times and detection success at exit and entry screening according to the screening sensitivities. An individual will be detected at exit screening if their infection is symptomatic i.e. has detectable fever, their departure time exceeds their incubation period, and their stochastic exit screening success indicates detection. An individual will be detected at entry screening if their infection is symptomatic, their incubation period ends after their departure but before their arrival, they have not been detected at exit screening, and their entry screening result is positive despite imperfect sensitivity. Entry screening detections are further divided into detection due to severe symptoms and detection of mild symptoms via equipment such as thermal scanners.		nCoV outbreak. The current outbreak has spread rapidly and early evidence suggests that the average disease severity is lower than that of SARS. This may also suggest a substantial proportion of asymptomatic cases.	
Non-Covid-19 Specific Studies					

Ref	Study Type / Sample/ population	Method	Sensitivity and specificity of screening checklists	Additional findings / Conclusions	Quality of study
10.	Review study		Temperature screening programs using infrared (IR) alone or with a questionnaire for mass screening are ineffective for detecting persons with infectious diseases. Under best-case scenarios, simulation studies suggest such screening will miss more than half of infected individuals. They are ineffective for mass screening because of the low number of infected individuals who have fever at the time of screening and inconsistent technique by operators. IR thermometry even when used with a questionnaire was not reliable for screening due to environmental temperatures, false answers to questionnaires, and use of fever-reducing drugs. Using such an approach to reduce infection risk from visitors and staff entering healthcare facilities could provide a false sense of safety.		Moderate
11.	737 ED patients	Of 737 patients who presented to our ED for possible SARS from March to June 2003, we enrolled 484 patients with a temperature .38.0°C (.100.3°F) (age .18 years). Dyspnoea, diarrhoea, travel, close contact, hospital exposure, and household history were identified as predictive indicators in the triage stage. The triage score was the total of six items.	With a one-point cutoff value, the sensitivity and specificity were 81.8% (18/22) and 73.6% (340/462). Leukocytosis, thrombocytopenia, lymphopenia, and CXR were identified as predictive indicators in the fever screening stage. Screening station scores (the sum of 10 items) consisted of triage scores, white blood cell count, and CXR. With a three-point cutoff value, the sensitivity and specificity were 95.5% (21/22) and 87.2% (403/462).		
12.	Entry & exit screening on travellers –	Primary travel screening: visual observation of travelers for signs of the infectious disease, measurement of	No cases of Ebola Virus Disease were detected through exit screening. None of the countries in West Africa that	Entry screening alone seems to be ineffective in preventing or delaying introduction of diseases	Moderate

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	systematic review	travelers' body temperature, and completion of a questionnaire by travelers asking for presence of symptoms and/or exposure to the infectious agent. Secondary travel screening: an in-depth interview, a focused medical and laboratory examination and second temperature measurement.	implemented entry screening for SARS detected any case. For Influenza Pandemic (H1N1) 2009 the detection rate ranged from 0.01 to 2.2 confirmed cases per 10,000 persons screened. A survey conducted by WHO showed an aggregate rate of 4 confirmed cases per 1,000,000 screened travelers for Influenza Pandemic (H1N1) 2009 in 10 countries. For EVD, no case was identified through entry screening measures. For Zika virus disease, five cases were identified and more than 21,000,000 persons screened. Routine entry screening measures for Dengue fever showed a detection rate of less than 8%. It should be noted that the diseases targeted by entry screenings such as SARS, EVD and the Influenza Pandemic (H1N1) 2009 have a very low prevalence among travelers, therefore the positive predictive value of entry screening is expected to be close to zero. Entry screening at airports implemented on routine basis proved to be successful in Taiwan (an island) in identifying about half of the imported cases of Dengue fever [7,10]. Twelve out of 59 imported cases of Influenza Pandemic (H1N1) 2009 were detected through entry screening within 54 days of entry screening [33]. In Japan, 6.6% (10/151) of Influenza Pandemic (H1N1) 2009 cases were identified by airport entry screening. Another study in Japan showed that only 11 confirmed cases of	to a country; however, it could be justified for severe diseases, as part of a set of measures complementing each other, after setting priorities and where there are available resources.	

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			Influenza Pandemic (H1N1) 2009 were detected through entry screening, but 633 cases were diagnosed among the Japanese population and about 20% of them had passed through the entry screening. The detection rate of Dengue fever and Chikungunya infection was higher than that of influenza. This can be attributed to the difference in the severity of symptoms and whether it can be observable or measurable when passing the entry points at airports, as well as the rate of persons who will ask for medical care in the health care system and will be captured by the routine surveillance system.		
13.	Screening on 28,197 pilgrims returning from Mecca	We aimed to find out whether there was any occurrence of MERS-CoV by performing screening on 28,197 returning pilgrims. Those with a body temperature of > 38 °C and respiratory symptoms were sent to the airport clinic to have an oropharyngeal swab and a bacterial culture.	Fifteen pilgrims had fever (> 38 °C) accompanied by respiratory symptoms; of these, 12 patients were diagnosed with upper and lower respiratory tract infections and three patients with pneumonia. However, none of them were found to be infected with MERS-CoV. The bacterial cultures showed evidence of normal flora growth.		Moderate

References Included in Summary

1. Wee, L. E., Fua, T. P., Chua, Y. Y., Ho, F. W. A., Sim, X. Y. J., Conceicao, E. P., ... & Tan, B. H. (2020). Containing COVID-19 in the emergency room: the role of improved case detection and segregation of suspect cases. *Academic Emergency Medicine*. Available from https://www.ncbi.nlm.nih.gov/pubmed/32281231
2. Hoehl, S., Rabenau, H., Berger, A., Kortenbusch, M., Cinatl, J., Bojkova, D., ... & Neumann, P. (2020). Evidence of SARS-CoV-2 infection in returning travelers from Wuhan, China. *New England Journal of Medicine*, *382*(13), 1278-1280. Available from https://www.ncbi.nlm.nih.gov/pubmed/32069388
3. Song, C. Y., Xu, J., He, J. Q., & Lu, Y. Q. (2020). COVID-19 early warning score: a multi-parameter screening tool to identify highly suspected patients. *medRxiv*. Available from http://medrxiv.org/content/early/2020/03/08/2020.03.05.20031906.abstract
4. Menni, C., Valdes, A., Freydin, M. B., Ganesh, S., Moustafa, J. E. S., Visconti, A., ... & Wolf, J. (2020). Loss of smell and taste in combination with other symptoms is a strong predictor of COVID-19 infection. *medRxiv*. https://www.medrxiv.org/content/medrxiv/early/2020/04/07/2020.04.05.20048421.full.pdf
5. Shi, Y., Wang, X., Liu, G., Zhu, Q., Wang, J., Yu, H., ... & Lu, G. (2020). A quickly, effectively screening process of novel corona virus disease 2019 (COVID-19) in children in Shanghai, China. *Annals of Translational Medicine*, *8*(5). Available from https://www.ncbi.nlm.nih.gov/pubmed/32309388
6. Nishiura, H., Kobayashi, T., Yang, Y., Hayashi, K., Miyama, T., Kinoshita, R., ... & Akhmetzhanov, A. R. (2020). The rate of underascertainment of novel coronavirus (2019-nCoV) infection: Estimation using Japanese passengers data on evacuation flights. Available from https://www.ncbi.nlm.nih.gov/pubmed/32033064
7. McIntosh, K., Hirsch, M. S., & Bloom, A. (2020). Coronavirus disease 2019 (COVID-19). *2020]. Disponível em:* https://www.uptodate.com/contents/coronavirus-disease-2019-covid-19-epidemiology-virology-clinical-features-diagnosis-and-prevention?sectionName=Strategies%20for%20PPE%20shortages&topicRef=127556&anchor=H7758381 45&source=see_link. *Acesso em*, *30*.
8. Gostic, K., Gomez, A. C., Mummah, R. O., Kucharski, A. J., & Lloyd-Smith, J. O. (2020). Estimated effectiveness of symptom and risk screening to prevent the spread of COVID-19. *Elife*, *9*, e55570. Available from https://www.ncbi.nlm.nih.gov/pubmed/32091395
9. 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), 2000080. Available from https://www.ncbi.nlm.nih.gov/pubmed/32046816
10. Clinical Evidence Assessment: Infrared Temperature Screening to Identify Potentially Infected Staff or Visitors Presenting to Healthcare Facilities during Infectious Outbreaks [Updated March 20, 2020] available from https://assets.ecri.org/PDF/COVID-19-Resource-Center/COVID-19-Clinical-Care/COVID-ECRI-Temperature-Screening.pdf
11. Wang, L. M., Chen, Y. C., Tung, S. P., Chen, C. Y., Chang, S. C., Chiang, S. C., & Lee, C. H. (2006). The rationale of fever surveillance to identify patients with severe acute respiratory syndrome in Taiwan. *Emergency medicine journal*, *23*(3), 202-205. Available from https://www.ncbi.nlm.nih.gov/pubmed/16498157
12. Mouchtouri, V. A., Christoforidou, E. P., Menel Lemos, C., Fanos, M., Rexroth, U., Grote, 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 and public health*, *16*(23), 4638. Available from https://www.ncbi.nlm.nih.gov/pubmed/31766548

13. Amin, M., Bakhtiar, A., Subarjo, M., Aksono, E. B., Widiyanti, P., Shimizu, K., & Mori, Y. (2018). Screening for Middle East respiratory syndrome coronavirus among febrile Indonesian Hajj pilgrims: A study on 28,197 returning pilgrims. *Journal of infection prevention*, *19*(5), 236-239. Available from https://www.ncbi.nlm.nih.gov/pubmed/30159042
14. COVID-19 Provincial Testing Guidance [Updated April 15, 2020] available from http://www.health.gov.on.ca/en/pro/programs/publichealth/coronavirus/docs/2019_covid_testing_guidance.pdf

Appendix: Evidence Search Details

Search Strategies

Database: Ovid MEDLINE(R) ALL <1946 to April 24, 2020>

Search Strategy:

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1 (exp coronavirus/ or coronavirus*.mp. or corona-virus.mp.) and (wuhan or beijing or shanghai or Italy or South-Korea or China or Chinese or 2019-nCoV or nCoV or COVID-19 or Covid19 or SARS-CoV*).mp. (7252)
2 (coronavirus* or Corona-virus or covid19 or "covid 19" or SARS-Cov*).ti. or (((novel or new or nouveau or "2019") adj2 (coronavirus* or corona virus*)).mp. and (exp china/ or china.mp. or Chinese.mp. or exp Italy/ or Italy.mp. or exp Republic of korea/ or south korea.mp.)) or ((pneumonia.mp. or exp pneumonia/) and Wuhan.mp.) (13993)
3 ("COVID-19" or "2019-nCoV" or "SARS-CoV*" or 2019-nCov or 2019 coronavirus* or 2019 corona virus* or covid19).mp. or exp Coronavirus Infections/ or ((novel or new or nouveau or "2019") adj2 (coronavirus* or corona virus* or Pandemi*2)).mp. (18912)
4 ("2019-nCov" or "COVID-19" or covid 19 or "SARS-CoV-2" or covid19).mp. or ((coronavirus* or corona-virus*) and (wuhan or shanghai or Beijing or Italy or south-korea or china or chinese)).ti,ab. (7780)
5 ((novel or new or nouveau or "2019") adj2 (coronavirus* or corona virus*)).mp. (3164)
6 1 or 2 or 3 or 4 or 5 (22075)
7 exp "Sensitivity and Specificity"/ (578257)
8 (sensitivity or specificity).mp. (1672063)
9 (predictive value? or diagnostic performance or case detection or prediction or predictive model?).mp. (512707)
10 (true positive or true negative or false negative or false positive).mp. (89219)
11 exp "reproducibility of results"/ (396909)
12 (reproducibility or (reproduc* adj2 (result? or finding? or propert*))).mp. (445784)
13 valid*.mp. (754103)
14 7 or 8 or 9 or 10 or 11 or 12 or 13 (2899880)
15 Mass Screening/ (102063)
16 "Surveys and Questionnaires"/ (456506)
17 (screening or questionnaire? or survey? or questions or ((triage or diagnos* or detect*) adj2 (tool? or aid?))).mp. (1940711)
18 early identification.mp. (14819)
19 15 or 16 or 17 or 18 (1951599)
20 6 and 14 and 19 (256)
21 limit 20 to yr="2019 - 2020" (65)
22 Body Temperature/ (47172)
23 temperature.mp. (819736)
24 22 or 23 (819736)
25 6 and 19 and 24 (37)
26 from 25 keep 4,13,17-18,24,34 (6)

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Database: Embase <1974 to 2020 April 23>

Search Strategy:

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1 (exp coronavirus/ or coronavirus*.mp. or corona-virus.mp.) and (wuhan or beijing or shanghai or Italy or South-Korea or China or Chinese or 2019-nCoV or nCoV or COVID-19 or Covid19 or SARS-CoV*).mp. (7845)
2 (coronavirus* or Corona-virus or covid19 or "covid 19" or SARS-Cov*).ti. or (((novel or new or nouveau or "2019") adj2 (coronavirus* or corona virus*)).mp. and (exp china/ or china.mp. or Chinese.mp. or exp Italy/ or Italy.mp. or exp Republic of korea/ or south korea.mp.)) or ((pneumonia.mp. or exp pneumonia/) and Wuhan.mp.) (13540)
3 ("COVID-19" or "2019-nCoV" or "SARS-CoV*" or 2019-nCov or 2019 coronavirus* or 2019 corona virus* or covid19).mp. or SARS coronavirus/ or ((novel or new or nouveau or "2019") adj2 (coronavirus* or corona virus* or Pandemi*2)).mp. (12635)
4 ("2019-nCov" or "COVID-19" or covid 19 or "SARS-CoV-2" or covid19).mp. or ((coronavirus* or corona-virus*) and (wuhan or shanghai or Beijing or Italy or south-korea or china or chinese)).ti,ab. (6840)
5 ((novel or new or nouveau or "2019") adj2 (coronavirus* or corona virus*)).mp. (3634)
6 1 or 2 or 3 or 4 or 5 (18114)
7 exp "Sensitivity and Specificity"/ (354487)
8 (sensitivity or specificity).mp. (1813774)
9 (predictive value? or diagnostic performance or case detection or prediction or predictive model?).mp. (794719)
10 (true positive or true negative or false negative or false positive).mp. (110508)
11 exp "reproducibility of results"/ (214553)
12 (reproducibility or (reproduc* adj2 (result? or finding? or propert*))).mp. (262283)
13 predictive validity/ or predictive value/ or exp validity/ or valid*.mp. (1212127)
14 effective*.mp. (2702643)
15 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 (5786906)
16 screening/ or exp mass screening/ or rescreening/ or screening test/ (466418)
17 "Surveys and Questionnaires"/ (679488)
18 (screening or questionnaire? or survey? or questions or ((triage or diagnos* or detect*) adj2 (tool? or aid?))).mp. (3361090)
19 16 or 17 or 18 (3362068)
20 6 and 15 and 19 (461)
21 limit 20 to yr="2019 - 2020" (132)
22 from 21 keep 93,100,104 (3)

PubMed

Search ((((((((((coronavirus[MeSH Terms]) OR ((coronavirus* OR corona-virus* or corona virus*))) OR ((((coronavirus* OR corona-virus*) and (wuhan OR beijing OR shanghai OR italy OR italian OR south-korea* OR south korea* OR china OR chinese OR 2019-nCoV OR ncov OR COVID-19 OR Covid19 OR SARS-CoV*))))))) OR ((((coronavirus*[Title] OR corona-virus*[Title] OR covid19[Title] OR covid-19[Title] OR "covid19"[Title] OR "covid-19"[Title] OR SARS-Cov*[Title]))) OR ((((((novel OR new OR nouveau OR "2019") and (coronavirus* OR corona-virus*)))) AND ((((((china[MeSH Terms]) OR (china OR chinese)) OR italy[MeSH Terms]) OR (italy OR italian)) OR korea, republic of[MeSH Terms]) OR south korea*))) OR ((((pneumonias[MeSH Terms]) OR penumonia*)) AND wuhan))))) OR ((((("COVID-19" OR "2019-nCoV" OR "SARS-CoV*" OR 2019-nCov OR 2019 coronavirus* OR 2019 corona virus* OR covid19)) OR coronavirus infections[MeSH Terms]) OR (((novel OR new OR nouveau OR 2019) AND (coronavirus* OR "corona virus*" OR Pandemi*)))) OR ((((("2019-nCov" OR "COVID-19" OR covid 19 OR "SARS-CoV-2" OR covid19)))

OR (((coronavirus*[Title/Abstract] OR corona-virus*[Title/Abstract])) AND (wuhan[Title/Abstract] OR shanghai[Title/Abstract] OR Beijing[Title/Abstract] OR Italy[Title/Abstract] OR south-korea[Title/Abstract] OR china[Title/Abstract] OR chinese[Title/Abstract]))) OR ((((novel OR new OR nouveau OR "2019") and (coronavirus* OR corona virus*)))))))) AND (((((((sensitivity and specificity[MeSH Terms])) OR (sensitivity or specificity)) OR (predictive value or diagnostic performance or case detection or prediction or predictive model*)) OR (true positive or true negative or false negative or false positive)) OR reproducibility of results[MeSH Terms]) OR reproduc*) OR valid*)) AND (((mass screening[MeSH Terms]) OR ("surveys and questionnaires"[MeSH Terms])) OR (screening or questionnaire* or survey* or questions or triage tool or diagnos* tool or detect* tool or triage aid or diagnos* aid or detect* aid))

Search terms used in a combination in other resources:

- Screening or diagnostic tool or triage aid
- Sensitivity or validity or prediction or predictive
- "self diagnosis" or diagnosis
- triage tool
- covid-19 OR coronavirus
- covid OR coronavirus
- risk assessment
- accuracy or validity or effective or sensitivity or specificity

Sources

- Medline
- PubMed
- Embase
- CINAHL
- Google & Google Scholar
- WHO, PHAC, CDC COVID datasets
- Cochrane Library
- medRxiv/bioRxiv
- See Evidence Search Report for full list of grey literature sources