Evidence check

9 April 2020

Rapid evidence checks are based on a simplified review method and may not be entirely exhaustive, but aim to provide a balanced assessment of what is already known about a specific problem or issue. This brief has not been peer-reviewed and should not be a substitute for individual clinical judgement, nor is it an endorsed position of NSW Health.

Thermal imaging for detection of fever

Rapid review question

Is mass thermal imaging an effective way of identifying people with COVID-19?

In brief

- Infrared thermal detection systems have been used to quantify skin temperature and provide an assessment of internal body temperature; they have been shown to be accurate in identifying people with no fever but much less so in identifying people with fever.
- Thermal detection systems have been used in border screening at airports for COVID-19 and in previous pandemics.
- While fever is a common symptom of COVID-19, early estimates of asymptomatic infections are between 18-42% of patients.
- According the World Health Organization (WHO), the virus can initially be detected in upper respiratory samples 1-2 days prior to symptom onset, suggesting potential pre-symptomatic transmission.
- Completely asymptomatic subjects display viral loads similar to those of symptomatic patients.
- A recent study of airport screening for COVID-19 estimated that using thermal screening, 46% of infected travellers would not be detected.
- Thermal screening will lack sensitivity to reliably detect COVID-19 cases in community settings.

Background

- Infrared thermal detection systems quantify skin temperature and provide a correlation with internal body temperature. The ability to provide quick, non-invasive temperature measurements is under consideration for use in mass fever screening during the COVID-19 pandemic.
- Epidemiological studies have shown that not everyone who has an infection or is infectious will have a fever.(1) Additionally, fevers can be lowered by using antipyretic medications.(2)
- Border screening at airports has been used in COVID-19 (3) and in previous pandemics such as Middle East respiratory syndrome (MERS) coronavirus (4), dengue fever (5), and H1N1 influenza (6).
- Currently, the technology is in use in airports in at least 20 countries, including Australia, Canada, Italy, Japan, Singapore and the USA.

Methods (Appendix 1)

Google and Pubmed were searched on 9 April 2020**.**

Results

Table 1: Evidence on thermal imaging		
Source title	Findings	Source link
Effectiveness of airport screening at detecting travellers infected with novel coronavirus (2019-nCoV) Quilty et al, 2020 (7)	Airport screening has been implemented previously during the 2003 SARS epidemic and 2009 influenza A (H1N1) pandemic, despite the limited evidence for its effectiveness. This was done to limit the probability of infected cases entering other countries or regions. The effectiveness of thermal passenger screening for 2019-nCoV infection at airport exit and entry was used to inform public health decision-making. In the baseline scenario, it estimated that 46% (95% confidence interval: 36 to 58) of infected travellers would not be detected, depending on incubation period, sensitivity of exit and entry screening, and proportion of asymptomatic cases. Airport screening is unlikely to detect a sufficient proportion of 2019-nCoV infected travellers to avoid entry of infected travellers.	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7014668
Evaluation of an Infrared Thermal Detection System for Fever Recognition During the H1N1 Influenza Pandemic Hewlett et al, 2015 (8)	Infrared thermal detection systems (ITDSs) have been utilised in several countries to screen for fever in travellers. This study assessed the in a clinical setting. This prospective study, conducted during the H1N1 influenza pandemic assessed the utility of the ITDS technology in a clinical setting. The sensitivity, specificity, positive predictive value (PPV), and negative predictive value of the ITDS to detect temperatures of ≥38.1°C in all enrolled patients were 0.58, 0.96, 0.40, and 0.98, respectively, and for temperatures of ≥38.3°C were 0.60, 0.97, 0.43, and 0.98, respectively.	https://pubmed.ncbi.nlm.nih.gov/21515982
Respiratory viruses in airline travellers with influenza symptoms: results of an airport screening study Jennings et al, 2015 (9)	Study investigates the use of a respiratory symptom screening tool at the border in predicting which travellers are more likely to be infected with specific respiratory viruses. The PPV of any symptom for any respiratory virus infection was low at 26%.	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7106445
Non-Contact Thermometers for Detecting Fever: A	The main types of non-contact thermometers are non-contact infrared thermometers, tympanic thermometers, and thermal scanners. Non-contact infrared thermometers are held 3-15cm away from the patient and typically measure temperature on the forehead or temple. Tympanic thermometers measure the thermal	https://www.ncbi.nlm.nih.gov/books/NBK263237

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Source title	Findings	Source link
Review of Clinical Effectiveness Canadian Agency for Drugs and Technologies in Health; 2014 (2)	radiation from the tympanic membrane and within the ear canal. Handheld thermal scanners can be used to take a person's temperature from a greater distance than other non-contact thermometers, which may make them a good candidate for use in mass screening situations. The optimal cut-off temperature for determining fever differs for each device. However, not everyone who has an infection or is infectious will have a fever. Additionally, fevers can be lowered by using antipyretic medications. The objective of this report is to determine the effectiveness and accuracy of non-contact thermometers for the detection of febrile individuals.	
Thermal Image Scanning for Influenza Border Screening: Results of an Airport Screening Study Priest et al 2011 (10)	Infrared thermal image scanners (ITIS) performed moderately well in detecting fever but in this study, during a seasonal epidemic of predominantly influenza type B, the proportion of influenza-infected travellers who were febrile was low and ITIS were not much better than chance at identifying travellers likely to be influenza-infected.	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3016318
Coronavirus disease-2019: Is Fever an Adequate Screening for the Returning Travelers? Bwire et al, 2020 (3)	Temperature screening is the major test performed at points of entry in countries with limited resources, however, recent reports on asymptomatic contact transmission of COVID-19, and of travellers who pass the screening but test positive for COVID-19 using reverse transcription polymerase chain reaction (RT-PCR) challenge this approach. Body temperature screening may miss travellers incubating the disease or travellers concealing fever during travel.	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7061485
Epidemiological trends and the effect of airport fever screening on prevention of domestic dengue fever outbreaks in Taiwan, 1998-2007. Int J Infect Dis. Kuan et al 2010 (5)	A total of 10,351 dengue cases, including 7.1% of imported cases were investigated between 1998 and 2007. The majority of indigenous dengue cases (98.5%) were significantly clustered in southern Taiwan; 62.9% occurred in the metropolitan areas. The seasonality of dengue cases showed a peak from September to November. Airport fever screening was successful in identifying 45% (244/542; 95% confidence interval 33.1-57.8%) of imported dengue cases with fever. However, no statistical difference was found regarding the impact on community transmission when comparing the presence and absence of airport fever screening.	https://pubmed.ncbi.nlm.nih.gov/20656647/
Mass Thermography Screening for Infection and Prevention: A	Infrared thermography (IRT) may be influenced by several confounding factors including age and outdoor temperature. In addition, results from studies looking at IRT as a tool to detect fever tend to have small PPVs	https://pubmed.ncbi.nlm.nih.gov/25520988

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Review of the Clinical Effectiveness Canadian Agency 2014 (11)	due to the small prevalence of febrile passengers. However, advantages of using IRT include its ability to screen mass numbers of individuals and reduce close contacts with infected individuals. One prospective study found that infrared thermography readings correlated moderately well with temperature readings taken using a conventional method (oral, aural, or axillary). One prospective study and four retrospective studies found that fever screening using a combination of infrared thermography, health declaration forms, and a conventional method at international airports had low sensitivity for detecting influenza viruses and dengue fever.	
Screening for Middle East Respiratory Syndrome Coronavirus Among Febrile Indonesian Hajj Pilgrims: A Study on 28,197 Returning Pilgrims Amin et al, 2018 (4)	A report of screening 28,197 returning pilgrims for Middle East respiratory syndrome coronavirus (MERS-CoV). 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.	https://pubmed.ncbi.nlm.nih.gov/30159042
Fever Screening During the Influenza (H1N1-2009) Pandemic at Narita International Airport, Japan Nishiura et al , 2011 (6)	Narita International Airport used an infrared thermoscanner (n = 1,049) from September 2009 to January 2010 to detect fever (38.0°C) in order to identify H1N1-2009 cases upon arrival. The sensitivity of fever for detecting H1N1-2009 cases upon arrival was estimated to be 22.2% (95% confidence interval: 0, 55.6) among nine confirmed H1N1-2009 cases, and 55.6% of the H1N1-2009 cases were under antipyretic medications upon arrival. The sensitivity and specificity of the infrared thermoscanners in detecting hyperthermia ranged from 50.8-70.4% and 63.6-81.7%, respectively. The PPV appeared to be as low as 37.3-68.0%.	https://pubmed.ncbi.nlm.nih.gov/21539735

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Appendix 1

((((((((((("diagnosis"[MeSH Subheading] OR "diagnosis"[All Fields]) OR "screening"[All Fields]) OR "mass screening"[MeSH Terms]) OR ("mass"[All Fields] AND "screening"[All Fields])) OR "mass screening"[All Fields]) OR "early detection of cancer"[MeSH Terms]) OR (("early"[All Fields] AND "detection"[All Fields]) AND "cancer"[All Fields])) OR "early detection of cancer"[All Fields]) OR "screen"[All Fields]) OR "screenings"[All Fields]) OR "screened"[All Fields]) OR "screens"[All Fields]) AND (((((("pandemic s"[All Fields] OR "pandemically"[All Fields]) OR "pandemicity"[All Fields]) OR "pandemics"[MeSH Terms]) OR "pandemics"[All Fields]) OR "pandemic"[All Fields])) AND ((((((("temperature"[MeSH Terms] OR "temperature"[All Fields]) OR "body temperature"[MeSH Terms]) OR ("body"[All Fields] AND "temperature"[All Fields])) OR "body temperature"[All Fields]) OR "temperatures"[All Fields]) OR "temperature s"[All Fields])