Public Health England

01 June 2020

Rapid evidence review: Temperature screening for reducing transmission of SARS-CoV-2

Review question

Is infrared temperature screening effective in reducing transmission of SARS-CoV-2?

Key messages

- A recent rapid review published by ECRI examined the effectiveness of temperature screening during infectious disease outbreaks. The review reported that temperature screening is not effective in this context due to low numbers of people with fever at the time of testing and measurement issues (related to testing devices and operators).
- The review findings on effectiveness were based on one systematic review (27 studies) and three simulation studies, all conducted in airports or other country entry / exit points. Only two simulation studies were focused specifically on COVID-19.
- An update of this rapid review was conducted to examine the most recent evidence on this topic (March 14th 2020 – April 21st 2020), but no new studies were identified.

Background

Temperature screening programmes have been implemented during infectious disease outbreaks in a variety of public settings including hospitals, ports and airports.(1) Various approaches have been taken and common tools to support population screening have included non-contact infrared thermometers, infrared cameras and scanners. Some of these devices, such as tympanic membrane thermometers, may also be used by individuals for the purpose of temperature measurement, although this was not a focus of this review. In the context of the COVID-19 pandemic, the evidence base for temperature screening to reduce transmission has emerged as an important public health question.

Previous studies have highlighted problems with the implementation of temperature screening as a public health intervention during infectious disease epidemics. Key challenges include:

- There are many causes of fever in humans, including conditions not being screened for
- Fever may be masked by antipyretic medications, e.g. paracetamol (2)
- Failure to account for asymptomatic transmission (i.e. individuals can spread infectious diseases in the absence of symptoms (3-5)
- Response bias or concealment when measurement is combined with self-report tools such as questionnaires (3, 5)
- Variability in the accuracy of measurement tools (6) and operator variability in use of measurement tools (7)

Specifically for SARS-CoV-2, it is essential to note that:

- Asymptomatic and / or pre-symptomatic individuals with SARS-CoV-2 infection may still have the potential to transmit the virus;(8)

- Not all symptomatic individuals with SARS-CoV-2 infection will experience fever and those that do may not experience it continuously (it is estimated that between 50% and 87% of symptomatic cases will experience fever at some point (9, 10) and this will vary during the course of the day)

Objective

The purpose of this review was to examine the effectiveness of temperature screening programmes for detecting and reducing transmission of SARS-CoV-2

Preliminary evidence scoping

A preliminary scoping search identified a rapid review recently published by the US-based Emergency Care Research Institute (ECRI) in March 2020.(1) That review examined the evidence base in two key areas relevant to temperature screening for disease outbreaks:

- the impact of temperature screening programmes in any setting on detection and transmission of infectious disease;
- the effectiveness and accuracy of alternative temperature screening tools.

The review assessed studies that examined temperature screening programmes implemented in airport and healthcare settings published from 1st January 2008 to 13th March 2020, including 2 systematic reviews (SRs), 3 simulation studies, 9 diagnostic cohort and case control studies and 2 case series. One of the systematic reviews and all of the simulation studies focused on effectiveness of screening, the remainder focused on accuracy of temperature testing tools. Accuracy of alternative temperature screening devices was not the focus of this updated evidence review and is not reported on.

Although the literature search of the ECRI literature search was comprehensive, risk of bias and quality of included studies were not formally assessed by the authors.

Key findings of the ECRI Institute review included:

- One systematic review including 27 studies examined exit and entry temperature screening at airports and ports in the context of any infectious disease reported case detection rates on entry as zero or very low for the influenza pandemic in Africa, and zero for SARS across several countries.(11) All studies were conducted at country entry / exit points (mostly airports). None of the included studies were of SARS-CoV-2.
- Two simulation studies of airport temperature screening in the context of COVID-19 reported case detection rates of between 30% and 54% respectively (3, 12) depending on different scenarios. The studies adopted different assumptions around the presence of fever, incubation period and accuracy of measurements.

The review authors concluded that mass infrared temperature screening alone is generally ineffective for detecting communicable diseases or reducing their transmission to other countries in the context of epidemics (1). Key reasons for this finding included the low proportion infected individuals who have a fever at the time of screening, and inconsistent

operator technique (1). This evidence was drawn entirely from studies at airports and other country entry / exit points and largely from low prevalence diseases.

Whilst not examined directly, additional benefits of temperature screening were highlighted including public education, raising awareness of ongoing outbreaks among travellers and discouraging symptomatic individuals from travelling (11).

Summary of methods

We conducted a rapid evidence review focused on the time period after that covered by the ECRI Institute review(1) to update the evidence base on the effectiveness of temperature screening in the context of COVID-19. Acknowledging evidence on the effectiveness of screening specifically in relation to COVID-19 may be limited, we did not limit the search by setting or infectious disease. The literature search covered the period from 14th March 2020 to 21st April 2020. An accelerated review process was used (described in Appendix A) and the process and methods were agreed prospectively by the review team.

Evidence

The database search returned 829 records; after removal of duplicates, 639 records were screened by title and abstract according to prospectively specified inclusion criteria. Of these, 32 full text articles were assessed for eligibility but **no studies met the inclusion criteria**.

A PRISMA diagram describing the literature search process is reported in Appendix B.

Limitations

The reliance on findings of an existing rapid review means relying on the authors' interpretation of their results. The absence of formal quality assessment of included studies means that their conclusions in relation to the effectiveness of temperature screening should be interpreted with caution.

Conclusions

Only two studies have examined the potential role of temperature screening for SARS-CoV-2, although when combined with indirect evidence from other outbreaks evidence suggests it is not an effective intervention. Evidence has largely been generated from studies of screening programmes at country entry and exit points, and its applicability to other settings warrants further consideration.

Our supplementary rapid evidence review did not identify any new evidence since publication of the ECRI review. However, given the pace of new evidence generation on COVID-19 it was important to check for new evidence to ensure up to date knowledge and this will need to be continued at regular intervals.

Areas for further research

Temperature screening programmes implemented during the COVID-19 pandemic should be evaluated to determine their effectiveness in improving detection and reducing transmission of SARS-CoV-2 in all settings.

In addition to evaluation of effectiveness, future research should address the potential wider impacts of temperature screening interventions in different settings, including discouraging travel among symptomatic individuals and improving public awareness.

Contact:

PHE COVID-19 Evidence: Covid19Evidence@phe.gov.uk

Disclaimer

The information in this rapid review summarises evidence from a literature search and may not be representative of the whole body of evidence available. It has been subject to internal, but not independent, peer review.

References

1. ECRI Institute. Infrared temperature screening to identify potentially infected staff or visitors presenting to healthcare facilities during infectious disease outbreaks. COVID-19 Clinical Evidence Assessment. 2020.
2. Sun G, Saga T, Shimizu T, Hakozaki Y, Matsui T. Fever screening of seasonal influenza patients using a cost-effective thermopile array with small pixels for close-range thermometry. Int J Infect Dis. 2014;25:56-8.
3. Gostic K, Gomez AC, Mummah RO, Kucharski AJ, Lloyd-Smith JO. Estimated effectiveness of symptom and risk screening to prevent the spread of COVID-19. Elife. 2020;9:e55570.
4. Aw J. The non-contact handheld cutaneous infra-red thermometer for fever screening during the COVID-19 global emergency. J Hosp Infect. 2020;104(4):451.
5. Bwire GM, Paulo LS. Coronavirus disease-2019: is fever an adequate screening for the returning travelers? Trop Med Health. 2020;48:14.
6. ECRI Institute. Infrared temperature screening to identify potentially infected staff or visitors presenting to healthcare facilities during infectious disease outbreaks. COVID-19 Clinical Evidence Assessment [Internet]. 2020. Available from: https://assets.ecri.org/PDF/COVID-19-Resource-Center/COVID-19-Clinical-Care/COVID-ECRI-Temperature-Screening.pdf.
7. Gostic KM, Kucharski AJ, Lloyd-Smith JO. Effectiveness of traveller screening for emerging pathogens is shaped by epidemiology and natural history of infection. Elife. 2015;4:e05564.
8. Buitrago-Garcia DC, Egli-Gany D, Counotte MJ, Hossmann S, Imeri H, Salanti G, et al. The role of asymptomatic SARS-CoV-2 infections: rapid living systematic review and meta-analysis. 2020:2020.04.25.20079103.
9. Michelen M, Jones N, Stavropoulou C. In patients of COVID-19, what are the symptoms and clinical features of mild and moderate cases? CEBM [Internet]. 2020. Available

from: www.cebm.net/covid-19/in-patients-of-covid-19-what-are-the-symptoms-and-clinical-features-of-mild-and-moderate-case/.

10. Coronavirus disease 2019 (COVID-19) in the EU/EEA and the UK– ninth update Stockholm: ECDC [Internet]. 2020. Available from: www.ecdc.europa.eu/sites/default/files/documents/covid-19-rapid-risk-assessment-coronavirus-disease-2019-ninth-update-23-april-2020.pdf.
11. Mouchtouri VA, Christoforidou EP, Menel Lemos C, Fanos M, Rexroth U, Grote U, et al. Exit and Entry Screening Practices for Infectious Diseases among Travelers at Points of Entry: Looking for Evidence on Public Health Impact. Int J Environ Res Public Health. 2019;16(23):4638.
12. Quilty BJ, Clifford S, Flasche S, Eggo RM. Effectiveness of airport screening at detecting travellers infected with novel coronavirus (2019-nCoV). Eurosurveillance. 2020;25 (5).

Appendix A: Methods

We conducted a rapid evidence review following an abbreviated process. The research questions, search strategy, eligibility criteria and review process were agreed prospectively by the evidence team and summarised in a review protocol (available on request). It was agreed the review would aim to capture only the most recent published literature not covered by the prior ECRI Institute rapid review.

Research question

1. What is the effectiveness of temperature screening programmes for detecting and reducing transmission of SARS-CoV-2?

Sources of evidence:

- Ovid Medline, Ovid Embase, PHE Covid-19 Endnote library (including preprints from medRxiv), TRIP, NICE Evidence, Scopus, Cochrane, Google.
- We supplemented database searches with hand-searching of reference lists of relevant papers.

Search strategy

The evidence search covered the period 14th March 2020 to 21st April 2020. Search terms covered key aspects of the research questions, including body temperature-based screening programmes, temperature testing and alternative screening methods. Article eligibility criteria are summarised in Table 2. The Ovid Medline search strategy is provided in Box 1.

Screening process

Reference lists were extracted using Endnote. Screening of titles and abstracts was performed independently by two reviewers and supported by Rayyan software. Studies on which the reviewers disagreed were included for full text assessment. Full text screening was performed by a single (third) reviewer.

Data extraction and evidence synthesis: Key results from included papers were extracted and reported by one reviewer.

Bias assessment: Due to the rapid nature of the work, a validated risk of bias tool was not used. However, major sources of bias were noted by reviewers.

Table 2. Eligibility criteria for evidence search

	Include	**Exclude**
Population	Any (Humans)	None
Setting	Any	None

	Include	Exclude
Intervention	• Temperature screening (any programme design) • Temperature testing (any method to detect fever)	
Context(s)	• Infectious/communicable disease outbreaks and epidemics • Cross-border threats to heath • Public Health Emergencies of International Concern (PHEIC) • COVID-19	None
Outcomes of interest	• Detection of communicable disease by screening programme • Transmission of disease • Detection of symptomatic individuals, e.g. fever • Outcomes relating to the usefulness of a temperature screening test, e.g. sensitivity, specificity, positive predictive value	
Study designs	• Systematic review • Rapid reviews • Simulation studies • Observational studies • Diagnostic cohort studies • Case control studies • Descriptive studies: case studies, case series, case reports • Clinical guidelines	• Animal studies • Editorials • Letters
Language	English	All other languages
Time period	From: **14th March 2020** To: **21st April 2020**	None
Literature	• Journal publications • Pre-prints (not peer reviewed) • Clinical guidelines • Policy documents	None

Box 1. Search strategy: Ovid Medline

1. exp Body Temperature/
2. exp Fever/
3. Thermography/
4. Thermometers/
5. Mass Screening/
6. "Surveys and Questionnaires"/
7. ((temperature or fever or febrile or thermography or thermomet* or thermal or airport* or infrared or infra-red) adj3 (screen* or monitor* or measure* or detect* or test or tests or testing)).tw,kw.
8. 1 or 2 or 3 or 4
9. 5 or 6
10. 8 and 9
11. 7 or 10
12. limit 11 to dt=20200314-20200421
13. limit 12 to english language

Appendix B. PRISMA diagram