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Perspective
EXPERT INSIGHTS ON A TIMELY POLICY ISSUE

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A Framework for Evaluating Approaches to Symptom Screening in the Workplace During the COVID-19 Pandemic

In December 2019, a novel coronavirus began to spread in Wuhan, China. The first case in the United States of what came to be called coronavirus disease 2019 (COVID-19), caused by the virus SARS-CoV-2 (short for severe acute respiratory syndrome coronavirus 2), was documented in the state of Washington in January, 2020 (Holshue et al., 2020), and over the next few months the disease spread rapidly, infecting millions of individuals across the country (CDC, 2020a). In addition to the direct tolls associated with illness and death, the waves of infection have overwhelmed the health care system and led to extensive closures of businesses and workplaces as states, institutions, and individuals attempt to stem further spread. After a peak of infections in the United States in April 2020, infections in many states began to drop, leading to state "reopenings." However, the easing of lockdowns and accompanying restrictions led to a second surge of cases affecting most of the United States. It is likely that the virus will continue to recede and surge as cities and states change their approaches to restrictions, with ongoing concerns about traveling and gathering in the near future, and significant impact on individual businesses and the economy at large as certain industries are formally closed and others experience much-reduced demand. The risks and uncertainty

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leave employers, in particular, with questions about how to safely reopen, or keep open, their workplaces in the United States.

This Perspective focuses on the decision to implement symptom screenings, particularly temperature checks, at the workplace. Any approach to screening is associated with risks and benefits. Key considerations include the likelihood of detecting infection, whether employees are reassured by the testing approach (and perceive that they are safer because of screening of other employees), the safety of employees being screened and of employees performing the screening, feasibility (including cost), and the protection of privacy and health information during screening. Little is known about the effectiveness of approaches to workplace screening during the COVID-19 pandemic. Based on available evidence, we present a framework for assessing approaches to workplace screening for infection with the SARS-CoV-2 virus. Our approach is intended to guide the thinking of any organization in weighing approaches to screening.

We begin by summarizing current guidance for workplace screening by the Centers for Disease Control (CDC), the World Health Organization (WHO), and the Occupational Safety and Health Administration (OSHA). We then summarize available evidence on the effectiveness of temperature screening, and finally we present our framework describing different approaches to workplace screening and assessing their relative effectiveness.

Background: Current Guidance on Temperature and Symptom Screening

For context, we begin with the guidance offered, as of July 2020, by three leading public health organizations. There is no single policy at a national level that is binding on workplaces as they reopen.

Centers for Disease Control and Prevention. The CDC suggests that employers and workplaces with workers at "higher risk of severe illness from COVID-19" should "consider conducting routine, daily health checks (e.g., temperature and symptom screening) of all employees" (CDC, 2020b). The guidance also applies to all bars and restaurants. Risk factors include being over age 65 and having "underlying medical conditions," including "chronic lung disease, moderate to severe asthma, hypertension, severe heart conditions, weakened immunity, severe obesity, diabetes, liver disease, and chronic kidney disease that requires dialysis" (CDC, 2020b). No evidence is cited for this recommendation, though the CDC notes that "screening or health checks will not be completely effective because asymptomatic individuals or individuals with mild non-specific symptoms may not realize they are infected and may pass through screening" (CDC, 2020c). Employers should "make health screenings as private as possible" and conduct them "in a way that helps maintain social distancing guidelines, such as providing multiple screening entries into the building" (CDC, 2020d). The CDC notes that "fever, cough, and shortness of breath are more commonly reported among people who are hospitalized with COVID-19," citing a study of 1,099 hospitalized COVID-19 patients, in which 44 percent presented with a fever at time of admission and 89 percent eventually developed fever symptoms (CDC, 2020e). The CDC also recommends that critical infrastructure workers without symptoms should "self-monitor under the supervision of their employer's occupational health program" (CDC, 2020e).

World Health Organization. The WHO recommends that employees who have returned from an area where COVID-19 is spreading or who have been exposed to a suspected case should monitor themselves for symptoms for 14 days and take their temperature twice a day (WHO, 2020a). Elsewhere, not specifically in the context of the workplace, the WHO recommends that "contacts of patients with laboratory-confirmed COVID-19 be quarantined for 14 days from the last time they were exposed to the patient" (WHO, 2020b).

Occupational Safety and Health Administration. OSHA guidance to employers planning to reopen clarifies that "neither the OSH ACT nor OSHA standards prohibits employer screening for COVID-19" as long it is "applied in a transparent manner applicable to all employees (i.e., non-retaliatory)" and maintains confidentiality as required by the Americans with Disabilities Act (OSHA, 2020). OSHA cautions, however, that temperature screening "may have limited utility on its own" since "people infected with SARS-CoV-2 can spread the virus even if they do not have signs or symptoms of an infection" (OSHA, 2020). Employers who conduct temperature screens should interpret results "cautiously" and should accompany screening with basic hygiene, social distancing, workplace controls, and employee training (OSHA, 2020).

Employers must make decisions that balance multiple factors.

Approaches to Symptom Screening

The lack of high-quality evidence to support temperature screening, coupled with the wide variety of options for implementing symptom screening in the workplace, means that employers must make decisions that balance multiple factors. In deciding on an approach to symptom screening in the workplace, there are several potential components to consider, each associated with risks and benefits.

We assume that, at a minimum, employees would be self-monitoring for symptoms of COVID-19. The approaches—except for no screening—involve some combination of verbal screening, screening via form or app, temperature-taking at home, and/or temperature check in the workplace. Table 1 summarizes approaches to symptom screening that combine the different components. The approaches are

1. **No symptom screening.**
2. **Self-monitoring at home, with verbal screening at the workplace (with and without temperature checks at home).** Employees are asked to self-monitor for symptoms and to check in at a distance of 6 feet with a screener on arrival to the workplace to affirm that they have no symptoms.

Each workplace can determine its own ratings for each approach along the dimensions depending on its particular context.

Employees may or may not be asked to check their temperatures at home prior to arrival.

3. **Self-monitoring at home, with paper or electronic form (app) screening at the workplace (with and without temperature checks at home).** Employees are asked to self-monitor and complete a paper form or app attesting that they have done so each day and have no symptoms and check in at a distance of 6 feet with a screener on arrival to the workplace to submit the form or check the app. Employees may or may not be asked to check their temperatures at home prior to arrival.
4. **Self-monitoring at home, with verbal screening and temperature check at the workplace (with and without temperature checks at home).** Employees are asked to self-monitor for symptoms. Employees may or may not be asked to check their temperatures at home prior to arrival; in either case, they have their temperature checked upon arrival (during which time, they affirm they have no other symptoms).
5. **Self-monitoring at home, with paper or electronic form (app) screening and temperature check at the workplace (with and without temperature checks at home).** Employees are asked to self-monitor and complete a paper form or app attesting that they have done so each day and have no symptoms. Employees may or may not be asked to check their temperatures at home prior to arrival; in either case, they have their temperature checked upon arrival.

For each of the approaches and their components, we consider the following five key dimensions: (1) likelihood of **detecting infection**; (2) **employee reassurance** (i.e., whether this action will tend to make employees feel safer at work); (3) **safety** of the screening interaction; (4) **feasibility** (including disruption to employee flow and cost); and (5) **privacy**. We note that no screening approach can mitigate the impact of the spread of COVID-19 by pre-symptomatic individuals or asymptomatic individuals.

Each approach is rated along these five key dimensions. These ratings were developed through subjective assessment by two reviewers—both physician researchers at the RAND Corporation—looking at each dimension based on the summary of each issue, and establishing consensus on the ratings. The dimensions were rated from 1 to 5 stars in terms of the effectiveness of this approach for achieving that dimension. Please note that this table is intended as a framework, and each workplace can determine its own ratings for each approach along the dimensions depending on its particular context.

Given the lack of an established framework for how to make decisions about symptom screening, in this section we enumerate and consider the benefits and drawbacks of the possible components that make up these approaches.

Approaches to Symptom Screening, Rated Along Key Dimensions

Approach	Detecting Infections	Employee Reassurance	Safety	Feasibility	Privacy
1. No screening	★	★	★	★★★★★	★★★★★
2a. Self-monitoring at home (no home temperature taking), verbal screening at the workplace	★★	★★★	★★★★	★★★★★	★★★★
2b. Self-monitoring at home (with home temperature taking), verbal screening at the workplace	★★★	★★★	★★★★	★★★★	★★★★
3a. Self-monitoring at home (no home temperature taking), paper/app screening at the workplace	★★	★★★	★★★★	★★	★★
3b. Self-monitoring at home (with home temperature taking), paper/app screening at the workplace	★★★	★★★	★★★★	★★	★★
4a. Self-monitoring at home (no home temperature taking), verbal screening and temperature check at the workplace	★★★	★★★★	★★★	★	★
4b. Self-monitoring at home (with home temperature taking), verbal screening and temperature check at the workplace	★★★	★★★★	★★★★	★	★
5a. Self-monitoring at home (no home temperature taking), paper/app screening and temperature check at the workplace	★★★	★★★★★	★★★	★	★
5b. Self-monitoring at home (with home temperature taking), paper/app screening and temperature check at the workplace	★★★	★★★★★	★★★★	★	★

NOTES: Approaches are ranked from 1 to 5. Ratings are relative to each other rather than absolute.

★	★★	★★★	★★★★	★★★★★

No Screening (Approach 1)

A workplace may decide to do no screening at all. For example, if a business has few employees coming in person the workplace, has low rates of community spread, is well ventilated, and/or rarely has in-person visits, the benefits of screening may not outweigh the drawbacks, and thus an organization may reasonably decide not to do any kind of screening. Other factors that may affect the decision to adopt any kind of screening could include

- ramifications for reputation if associated with a cluster of illness
- size of organization
- density of workplace and type of work (e.g., high-contact work versus ability to distance)
- ventilation
- contact with colleagues who are unable to socially distance outside of work
- use of masks/face shields at work
- work setting and population served, such as health care or long-term care settings versus others, with more-vulnerable populations or more physical contact required.

Depending on these factors, a workplace might elect to do no screening.

Self-Monitoring and Verbally Affirming Lack of Symptoms Daily (Included in Approaches 2a, 2b, 4a, 4b)

Employees would typically be asked to familiarize themselves with a list of symptoms of COVID-19 and check in with a screener every day upon arrival (from a minimum distance of 6 feet), following a procedure recommended by the CDC focused on social distancing (rather than requiring barrier controls, such as a plexiglass barrier, or protective equipment, which are alternative options for protecting the screener).[1] This self-monitoring and -affirming approach means that employees would indicate that they have screened themselves for specific symptoms that day and have been symptom-free for the past 24 hours. The screener would perform a visual check of the employee, looking for obvious signs of illness.

Analysis of This Component

- **Likelihood of detecting infection.** Verbal symptom screening should capture all infections that are symptomatic (55–75 percent, noting that people are infectious prior to symptoms), with the caveats that employees must be aware of symptoms (e.g., must be aware of fever even if they did not take their own temperature that day) and must be truthful about their symptoms. The act of affirming that they are symptom-free may induce greater honesty than simply asking employees to report symptoms if they

[1] From the CDC (2020d):

- **Reliance on Social Distancing:** Ask employees to take their own temperature either before coming to the workplace or upon arrival at the workplace. Upon their arrival, stand at least 6 feet away from the employee and:
  - Ask the employee to confirm that their temperature is less than 100.4° F (38.0° C), and confirm that they are not experiencing coughing or shortness of breath.
  - Make a visual inspection of the employee for signs of illness, which could include flushed cheeks or fatigue.
  - Screening staff do not need to wear personal protective equipment (PPE) if they can maintain a distance of 6 feet.

occur. However, there is no evidence on whether individuals are more likely to be honest when face-to-face with another human being versus reporting to an app when screening for infection.

- **Employee reassurance.** Verbal symptom screening is likely to moderately reassure employees, as seeing a person conducting the screening may suggest greater seriousness about risk. Compared with a form or an app, screening face-to-face may reassure employees more, but, as discussed below, employees might also find a form or app as reassuring for different reasons.
- **Safety of screening interaction.** Safety is highest for employees, given maintenance of distance at all times between the employee and the verbal screener and between the employee and other employees, compared with temperature checks in the workplace; safety is still high for screeners, though they must interact with each individual who enters the workplace, albeit from a distance.
- **Feasibility.** Verbal symptom screening is quite feasible, because it requires minimal equipment and no deployment of a new paper form or app. There is a risk to disrupting flow of entry into the workplace because of the need to funnel employees to a screener, but there is still less disruption than with the other approaches (because this approach is the fastest). The main costs are screener time and screens for privacy.
- **Privacy.** Employees have to report that they are free of symptoms, but otherwise this screening requires minimal collection of health information, and no health information is retained.

Verbal symptom screening is quite feasible, because it requires minimal equipment and no deployment of a new paper form or app.

Self-Monitoring and Affirming Lack of Symptoms via Paper or Electronic Form (Included in Approaches 3a, 3b, 5a, 5b)

Employees would complete a record indicating whether they have symptoms (either reviewing a list of symptoms and recording yes/no in response to a question about presence of any symptoms or checking off the presence/absence of each symptom). The record could be on paper, an online form, or an app. Employees would be asked to check in every day with a screener upon arrival from a distance of at least 6 feet to either show a "pass" through the app (or print-out) or a completed paper form (and for a visual screening for obvious signs of illness). Note that a variation on this approach would be to have responses recorded with personal information in a database, with no checking of form completion upon arrival to the workplace.

Analysis of This Component

- **Likelihood of detecting infection.** Screening via a form should capture infections at the same rate as simply affirming lack of symptoms to a screener (although as noted above, it is unknown whether people may be more honest when face-to-face with a screener or whether the act of documenting symptoms may make people more likely to report symptoms).

- **Employee reassurance.** Screening via a form may reassure employees somewhat more than a verbal affirmation without a form because it feels more formal and structured (though likely somewhat less reassuring than if combined with temperature screening).
- **Safety of screening interaction.** The safety is high, as long as the employee does not need to come within 6 feet of the screener to show the app or hand in a form. If paper forms and pens are provided, there could be a risk of surface contamination (which could be minimized by separating used pens from clean pens and emphasizing careful hand hygiene).
- **Feasibility.** Screening via a form is less feasible than a verbal affirmation, given the need to develop a form, ensure no contamination of the paper form, and the possible need to develop an app. It may take longer than verbal affirmation as some employees may forget to complete the form and need to be reminded. It would also cost more than the verbal affirmation approach. The main costs are form/app development, pens/paper (if provided), screener time, and screens for privacy.
- **Privacy.** Employees may have to report specific symptoms (unless they are only asked to document the absence of all symptoms, in which case this approach is equivalent to verbal affirmation). It would be possible to take an approach in which no health information is retained (forms would be destroyed, or the app does not retain data), but employee concerns about health information privacy may be elevated.

Temperature Screening at Home by Employees (in Conjunction with Symptom Screening) (Included in Approaches 2b, 3b, 4b, 5b)

Employees would be asked to actively check their temperature at home as part of their affirmation that they have no symptoms. Typically, they would be asked to check their temperature once daily prior to coming into the workplace.

Analysis of This Component

- **Likelihood of detecting infection.** Asking employees to check their own temperature at home should capture infections at a slightly higher rate than questionnaire-only symptom screening, assuming that some employees may not realize that they have a fever. It may also drive home the importance of not coming in with symptoms. Again, this assumes that employees will be truthful about their symptoms.
- **Employee reassurance.** Temperature checking at home may reassure employees somewhat more than generally attesting that they have no symptoms.
- **Safety of screening interaction.** Having employees check their temperature at home is safer for the

screener and employees than not asking employees to the check their temperature at home, because those identifying fever at home may choose not to come in as a result.

- **Feasibility.** Temperature checking at home is generally quite feasible. Possible barriers include employees not having thermometers (though these could be provided by the workplace), employee resistance, and employee fatigue after following this approach for some time. This approach has minimal additional cost, unless the workplace purchases thermometers for employee who do not have them.
- **Privacy.** There should be no impact on privacy, unless temperatures are recorded somewhere and retained by the employer.

Temperature Screening at the Workplace (in Conjunction with Symptom Screening) (Included in Approaches 4a, 4b, 5a, 5b)

Employees would be screened by another individual, using either an infrared thermometer or a thermometer that can be cleaned between uses. Overall, evidence is lacking for this approach (see next section for more information).

Analysis of This Component

- **Likelihood of detecting infection.** Temperature screening at the workplace may capture infections at a slightly higher rate than symptom screening, though the accuracy of infrared thermometers (if used) is questionable (see below in literature review). However, the marginal utility seems limited, particularly if employees could instead be asked to take their temperature at home, as discussed previously. The marginal utility of temperature screening at the workplace is to detect employees who are not telling the truth about their fever or who refused to check their temperature at home and did not know they had a fever. In the case of employees who want to come to the workplace despite suspecting or knowing that they have a fever, fever-reducing medication could easily be used to evade a positive screen.
- **Employee reassurance.** Temperature screening may reassure employees more than the other approaches described here because it is a visible process that checks for an objective sign of illness.
- **Safety of screening interaction.** Performing a temperature check means that employees and the individual performing the screening must come within 6 feet of each other. Although the screener would wear personal protective equipment (PPE) and/or have a plexiglass barrier, this approach may still make some employees uncomfortable. Those performing the screening—who may also be employees at the workplace themselves—may also feel they are at risk despite their PPE.

The marginal utility of temperature screening at the workplace seems limited.

- **Feasibility.** Feasibility is lowest of all the approaches we considered. Temperature screening requires special equipment, PPE, and extensive training of screeners. It will take the longest of the approaches to perform and may affect the flow of employees into the workplace. It is the most expensive of the approaches described because of staffing and equipment needs. Unlike symptom screening (which could even be done via a video call to a central location), temperature screening requires the physical presence of employees to perform.
- **Privacy.** Temperature screening at the workplace would have some impact on privacy, given that it may be obvious to others if an employee has a fever and is checked multiple times. Otherwise, there is no further risk to privacy, unless temperatures are recorded somewhere and retained by the employer.

Evidence Regarding Temperature and Symptom Screening

We performed a targeted scan of the peer-reviewed and grey literature on May 8, 2020, to identify current evidence for the use of temperature and symptom screening, with a focus on infrared temperature screening, because these methods are being increasingly used in public places, such as airports, in the United States. We searched the published literature via PubMed with search terms such as *covid screening* and *covid fever*, and we reviewed the literature cited by UpToDate and other medical sites. To identify the most recent work, we first reviewed publications by major health organizations, such as the WHO and CDC, and the literature they cited. We then conducted other web searches for evidence from peer-reviewed sources on the evidence for screening for fevers in general and for fever and symptoms of COVID-19 in particular. This search was not systematic; for each topic, we attempted to identify the most recent and reliable data. The evidence for screening practices in identifying cases is limited, and it is based primarily on case studies, case reports, observational studies, and other evidence reviews, and there is even less evidence about reducing disease spread. A brief narrative summary of what we found is presented here.

Fever and COVID-19

Temperature screening is a natural consideration for COVID-19 because it is the noninvasive objective screening approach and is easier to implement than routine testing of employees. Although a fever is not a specific sign of COVID (meaning it be a sign of many other infectious or non-infectious diseases), nor a sensitive one (meaning it will miss presymptomatic or asymptomatic infected individuals), in the setting of a pandemic it can serve as a "red flag" for infection.

Temperature checks have been used to screen for other viral infectious outbreaks, such as Severe Acute Respiratory Syndrome (SARS) and Middle East Respiratory Syndrome (MERS), in the past few decades. However, fever occurs less frequently with COVID-19 than with SARS (99 percent) or MERS (98 percent) (Zumla, Hui, and Perlman, 2015), so the utility of temperature checks would be even lower for COVID-19 than for these infections. For example, three studies found fever in 98 percent of hospitalized COVID-19 patients (Yang et al., 2020; Huang et al., 2020; Wang et al., 2020), but, in one (Huang et al., 2020), approximately

20 percent had their highest temperatures below 100.4°F (criterion for fever was only 37.3°C or 99.1°F). Other studies found a rate of fever of 94 percent (again using 37.3°C axillary to define fever; Zhou et al., 2020) and 77 percent in hospitalized patients in China (again, with more than 50 percent of these fevers being below 100.4°F; Xu et al., 2020). When distinguishing between the time of presentation and any time during hospitalization, the numbers fall: Guan et al., 2020, reports only 43.8 percent febrile on admission and 88.7 percent any time during hospitalization. Similarly, in New York, Richardson et al., 2020, found that 30.7 percent of patients were febrile on presentation. None of these studies focused on rates of fever in the community. Thus, while rates of fever in the hospital are high, these are not the relevant rates to consider for community-based screening.

Random screening outside the hospital have found lower rates of fever among SARS-CoV-2-positive patients. When all residents of a homeless shelter population in Boston were tested, there was a 36 percent case positivity rate, but "the majority of individuals with newly identified infections had no symptoms and no fever at the time of diagnosis" (Baggett et al., 2020). Similarly, women in New York City who were pregnant during a time of widespread community transmission were all screened on admission to the hospital; of the 33 out of 215 who tested positive, 29 (87.9 percent) had no symptoms (including fever) of COVID-19 at presentation, and only three of those developed fever before postpartum discharge (usually two days later) (Sutton et al., 2020). Thus, fever is not ubiquitous.

Another issue is the delay in manifestation of a fever. A fever may not appear until more than a week after other symptoms begin: In one study of 52 critically ill COVID-19 patients, six (11 percent) did not experience fever until two to eight days after the onset of symptoms (Yang et al., 2020).

> Many people have no fever at all and can still transmit COVID-19.

Many people have no fever at all and can still transmit COVID-19. There is strong evidence for transmission of SARS-CoV-2 by asymptomatic individuals (Bai et al., 2020; Rothe et al., 2020). The number of patients who are asymptomatic may range from 18 percent to 40 percent or higher, according to several reports (Mizumoto et al., 2020; WHO, 2020c; Oran and Topol, 2020; CDC, 2020f). The CDC also notes that atypical presentations have been described, with older adults and persons with medical comorbidities potentially having delayed presentation of fever and other symptoms (CDC, 2020e).

One consideration is that, while temperature screening will inevitably fail to detect potentially infectious asymptomatic spreaders, it might be of high yield if it identifies an employee who would have otherwise infected a large number of people at one time. Large clusters of COVID-19 have occurred that are due to a single "super-spreader" (Aschwanden, 2020), and there have been location-based cases, such as in Michigan, where 107 cases were linked to a single bar (*The Detroit News*, 2020). Temperature screening might prevent some of these cases, though it is

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unknown how often such "super spreader" individuals are symptomatic during spread.

Efficacy of Infrared or Other Temperature Screening (COVID-19-Specific)

Our reviews identified no high-quality evidence specific to the efficacy of screening temperature for COVID-19. The U.S. Food and Drug Administration (FDA) notes the advantages of noncontact infrared thermometers, which are less likely to spread disease, are easy to use, and provide a result quickly; the FDA also notes the limitations of these devices, including that the result may be affected by the way the measurement is done (U.S. Food and Drug Administration, 2020).

Addressing accuracy, in a letter from Taiwan on COVID-19 screening, authors reported that, despite temperature checks outside the hospital at an "outdoor quarantine station," only five fevers were caught; the rapid screening (infrared or forehead thermometer not specified) missed 37 individuals who had fevers when checked a second time inside at the clinic (thermometer not specified). Screeners may have missed infected individuals because other factors were influencing body temperature, including low ambient temperatures and recent administration of antipyretic medications (Hsiao, 2020). Sweating can also lead to inaccurate readings (Morán-Navarro et al., 2020).

In another letter regarding practices to identify infected patients in cardiology clinics, a researcher in Germany, summarizing the current knowledge as of April 2020, made the following recommendations: "Infrared non-contact temperature measurement may be used to check patients' body temperature at the entrance, although this method is controversial and not very reliable. A normal body temperature should never be the only parameter used to rule out COVID-19 with certainty. However, an elevated body temperature is a reason for further SARS-CoV-2 testing" (Dörr, 2020).

An attempt to estimate the effectiveness of airport screening for carriers of SARS-CoV-2 using a simulation of 100 travelers estimated that 46 percent (95 percent confidence interval: 36 to 58) of infected travelers "would not be detected, depending on incubation period, sensitivity of exit and entry screening, and proportion of asymptomatic cases" (Quilty et al., 2020). This article concluded, "Airport screening is unlikely to detect a sufficient proportion of 2019-nCoV infected travelers to avoid entry of infected travelers" (Quilty et al., 2020).

Efficacy of Infrared Temperature Screening (Non-COVID-19)

Given the lack of evidence of temperature screenings for COVID-19, we expanded our search to other infections, but we found limited evidence for the efficacy of infrared temperature screening, even in non-COVID-19 scenarios.

A 2015 study of "cutaneous infrared thermometry" found that "Although commonly used in mass fever screening, the current performance characteristics of CIT [cutaneous infrared thermometry] are limited and may add little to detection of target diseases in a mass screening context" (Hogan, Shipman, and Smith, 2020). Some of the tools have low sensitivities, meaning a higher rate of false negatives, which could be dangerous in a mass screening context (Tay et al., 2015).

Similarly, noncontact handheld cutaneous infrared thermometers are operator-dependent and have low sensitivity, which raises questions about relying on these tools to screen for fevers (Aw, 2020). And as previously noted, other factors affect accuracy, such as the use of fever-reducing medications to evade screening (Tay et al., 2015; Sun et al., 2020), ambient temperature and the need for a steady, temperature-controlled environment (Tay et al., 2015), and waxing and waning of fevers during an infectious disease episode (Tay et al., 2015).

For the purposes of specific disease transmission in past infectious outbreaks, temperature screening has had a low yield: Kuan et al., 2010, found that airport fever screening was successful in identifying only 45 percent of imported Dengue cases with fever and had no impact on community transmission when compared with not screening. Similarly, when assessing the use of infrared thermal image scanners for influenza in 2011, Priest et al. (2001) found that the proportion of influenza-infected travelers who were febrile was low, so the tool was "not much better than chance at identifying travelers likely to be influenza-infected."

ECRI, an evidence-based research institute, conducted an analysis of all the available evidence as of mid-March 2020 and concluded that "Temperature screening programs using IR [infrared] alone or with a questionnaire for mass screening **are ineffective for detecting infected persons**, based on our review of evidence from 2 large systematic reviews (SRs), 3 simulation studies, and 6 diagnostic cohort studies (not included in the SRs)" (ECRI, 2020; emphasis added).

Symptom Screening

Screening of symptoms has been associated with positive COVID-19 tests in health care workers. In one study, self-reported loss of smell/loss of taste, fever, and myalgia (muscle aches) were the strongest independent predictors of positive assays (Lan et al., 2020). A similar study of health care workers found that screening for self-reported fever, shortness of breath, dry cough, or loss of taste or smell was highly sensitive but had low specificity, meaning it effectively caught cases but also flagged many false positives (Clemency et al., 2020).

Several applications have been developed to assist individuals in self-screening. These include a CDC symptom checker, which is publicly available online and could potentially be used by workers (CDC, 2020g). Apple has created a COVID screening tool, which is similar to the CDC's and was developed in partnership with the CDC (Apple, Inc., 2020). Other studies have used apps to study frequency of symptoms, which has helped identify the high specificity of loss of taste/smell (Menni et al., 2020). Because it is not yet clear which symptoms are most predictive, different apps collect different symptoms (Jain and Yuan, 2020).

There is evidence of the usefulness of asking individuals about symptoms, including fever and loss of taste/smell, in screening.

In short, temperature measurements alone seem insufficient to accurately identify COVID-19 cases, given the low accuracy of the tools and the low rate of fever in non-hospitalized infected patients. However, there is evidence of the usefulness of asking individuals about symptoms, including fever and loss of taste/smell, in screening.

Choosing an Approach for a Workplace

There is no "right answer" on how organizations should approach workplace symptom screening for COVID-19—the evidence on the topic is incomplete, and the challenges the pandemic poses continue to change. However, clearly delineating the factors to consider and prioritize makes decisionmaking more transparent and responsive, especially in the face of changes in information and context. Workplaces vary widely, with a large university, for example, having different needs and resources than a small convenience store. Even among similar kinds of organizations, leadership may prioritize the dimensions of detecting infections, employee reassurance, safety, feasibility, and privacy in different ways, and this prioritization may shift over time and as local conditions change. The current degree of community spread and prevalence is also critical to consider. We note that local risk varies significantly across the country and has changed over time, which may affect the need to implement screening. For example, in Los Angeles in June, asymptomatic infection prevalence was estimated at 1/400 but only a week later had increased to 1/140 (Shalby and Dolan, 2020). Weather is another factor that may serve as a barrier to some approaches: If core body temperature is falsely reduced upon arrival to work during cold weather (or falsely elevated during warm weather or after exercise), the temperature reading may not be accurate in either direction. Additionally, as previously noted, infrared thermometers require a steady temperature-controlled environment to be used accurately.

Regardless of the specific symptom screening approach implemented by an organization, regular reassessment will be critical. The chosen approach may need to be changed depending on any number of factors, including changes to local/state guidance, the number of confirmed/suspected infections among employees, how effectively health screening is identifying potential cases, and how it could be improved. We suggest outlining measures to be proactively monitored, such as the number of employees who screen positive (daily or weekly, depending on an organization's volume of screening) and the screening outcomes (that is, the ratio of identifications of true illness versus all positive screens), cost, impact on flow of entry of employees, and employee reactions (assessed either qualitatively or more rigorously through ongoing workplace surveys that may be in place), as well as tracking in-person presence to enable contact tracing, should cases arise. We also note that we have not addressed other workplace policies—such as masks, physical barriers (such as plexiglass screens), physical distancing, and disinfecting workspaces—that can reduce risk of transmission in the workplace but are beyond the scope of this paper.

Our framework allows for an evidence-based customization of workplace approaches to screening that has the advantage of facilitating clear communication to employees about the rationale for the choice of screening approaches.

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About This Perspective

The authors of this Perspective assess approaches, including temperature checks, to workplace screening for COVID-19 symptoms, rating the approaches on five criteria: likelihood of detecting infection, helping employees feel safer, safety of the screening interaction, feasibility, and privacy.

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