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Temperature Screening and Civil Liberties During an Epidemic

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As Americans look beyond the current coronavirus lockdowns, there has been a lot of discussion about the role of technology in a new, more open phase of the pandemic response. Many experts envision a world where widespread testing is combined with careful disease surveillance and contact tracing in an effort to suppress transmission enough to allow some cautious semblance of normality until researchers are able to develop a vaccine. A range of proposals have been offered, including using cell phone data for contact tracing, which we have analyzed at length.

Another technology that is often mentioned is remote or "standoff" fever detection. Some companies have already begun screening their workers for fevers, and restaurants their customers. Manufacturers report being swamped by sales and inquiries. In China, temperature screening checkpoints have been set up everywhere from markets to subway and building entrances to highway roadblocks.

What are we to think about the use of this technology to fight coronavirus transmission from a privacy and civil liberties standpoint?

Effectiveness

The first question is always effectiveness. If a technology can't deliver what it promises, it should not be deployed. If it works poorly, that fact should be taken into account when it is weighed against privacy or other values. Temperature screening should only be done if, where, and in ways that public health experts believe will actually meaningfully contribute to combatting the pandemic. Currently, experts say that there are sharp limits to its potential usefulness in detecting COVID-19.

First, elevated body temperature can be caused by many factors other than COVID-19,

including exercise, emotional state, and other illnesses. As one medical article put it, "One has to keep in mind that screening for fever and screening for a virus are two different issues." In these instances, fever detection will be *over*-inclusive.

Second, body temperature measurement will do nothing to detect infected people who don't have a fever. COVID-19, unlike some other diseases such as Ebola, is contagious well before symptoms appear, and many infected people — perhaps even most — never do get any symptoms, much less fever. In addition, there is a lot of variation in people's body temperatures; what is a fever for one person could be a normal temperature for another. Finally, even those who do have fevers caused by COVID-19 can suppress them by taking antipyretic medicine like aspirin or ibuprofen. In these instances, fever detection will be *under*-inclusive.

Third, standoff fever detectors are of highly questionable accuracy. In addition to internal (usually oral or anal) thermometers, which are regarded as the gold standard of accurate temperature measurement, there are three primary kinds of thermometers:

1. "Tympanic" thermometers, which are inserted into the ear to measure heat in the tympanic membrane;
2. "Thermometer guns," or "non-contact infrared thermometer" (NCITs), which are held 3-15 cm away from the subject's skin, typically at the forehead; and
3. Standoff thermal cameras that try to detect body temperature from further away.

All of these devices have to be used correctly, which is not necessarily easy for those who aren't medical professionals. Assuming proper use, ear thermometers have proven to be reasonably accurate, but a number of studies have found that the other two, which measure surface skin rather than core body temperature, are of questionable accuracy. Skin temperature can be affected by such things as sunburn, alcohol consumption, moisture on the skin such as sweat, or hot or cold air temperatures.

As one industry analyst put it, "Some people who have elevated skin temperature (EST) may have elevated body temperature (EBT). Some of those people with EBT may have a fever. Some of those people with a fever may have coronavirus." But that is a narrow path to accuracy.

Nevertheless, products marketed as "fever detectors" (and sometimes even "coronavirus detectors") are flooding the market. In China, thermometer guns have been found "unreliable outside carefully controlled health care settings." Indeed, the FDA has published a long list of finicky requirements for their proper use. There are even more questions about thermal cameras. The flood of new products has been encouraged by the FDA, which announced that during the pandemic it would allow thermal cameras to be used as unapproved fever detection devices even though the agency considers them to be medical devices. The FDA did set some important qualifications, however. It said that such devices should:

- Only be used to measure one subject at a time;

- Only be used in conjunction with a more accurate backup means of measuring temperature; and
- Include a "prominent notice" reminding operators how "different environmental and system setup factors" can influence a device's accuracy. Those factors include where on the human body a temperature is measured as well as the "screening background, ambient temperature and humidity, [and] airflow" at the camera location.

The FDA's caution is backed up by testing carried out by the independent camera testing and review site IPVM, which found significant accuracy issues with cameras on the market. The difference in temperature between a healthy and febrile person — especially those with low-grade fevers who are more likely to be out and about — is quite minor. The typical precision claimed by the scores of companies now offering such products is 0.3 - 0.5 °C (0.54 - 0.9° F) — but the reviewers were "skeptical of actual field accuracy as these are likely overinflated," and found cameras on the market that were far less accurate. Camera positioning was also a problem since recording subjects from the side, or subjects who are moving, "significantly reduces" accuracy.

Like temperature guns, thermal cameras are also apparently very finicky with regards to calibration. Even in controlled environments, they are highly sensitive to room and climate conditions and often need hourly calibration reviews. Many of the most accurate thermal cameras utilize "blackbody devices" — essentially small heaters that maintain an exact temperature — which have to be mounted within a camera's view and at the same distance as the subject for proper calibration. Readings can be disrupted by hats, sunglasses, masks, and hair over the face. And, as IPVM notes in a dismissive review of one company's fever detecting sunglasses, "virtually none of the large providers of thermal fever cameras are recommending such outdoor, on the move applications" because there is an "engineering consensus" that such uses are "not reliable."

As IPVM, which has caught several companies making false marketing claims, sums up the situation:

A core issue is there are no independent tests of thermal camera performance/accuracy and no independent standards to measure against. This has allowed manufacturers to tout products meant for body/fire detection as a fever solution, or falsely claim pinpoint accuracy at long distances.

By this point, given this litany of challenges, it should be apparent just how far-fetched is the concept of a "Coronavirus-detecting drone" like the Draganfly aircraft briefly considered by a Connecticut town. Given the FDA's stipulation that unapproved fever-detecting cameras only measure one person at a time, such a device may not even be legal. But the Draganfly and fever-detecting sunglasses are not the only unlikely products; companies are marketing less flashy devices that still purport to be able to scan dozens of people at once, in movement, and at long and varying distances.

The thermal cameras that are most accurate (which can cost two to four times as much as a typical $15,000 system) are designed to scan only a single person at a time (per the FDA's guidance), and to do so frontally, at close range, and on still subjects. Overall, however, there is a veritable gold rush of companies scrambling to put "fever detectors" on the market and cash in on the crisis. The result is accuracy levels that appear to be all over the map and a certain degree of snake oil.

The bottom line is that nobody should imagine that blanketing our public spaces with thermal sensors is going to serve as any kind of effective automated "COVID detection network," or that this technology is likely to contribute significantly to stemming the spread of the virus.

Some will argue that despite all these shortcomings, the possibility of detecting some cases is better than nothing, and that temperature screening could therefore have some role in suppressing the disease before a vaccine is developed. There may be some truth in that view, though such a possibility needs to be balanced against three significant risks:

1. If there are too many false positives, that could waste resources, annoy people (leading to circumvention), and create a "Boy Who Cried Wolf" effect, causing operators to ignore even true positives. All of that would reduce the effectiveness of temperature screening even further and potentially even be counterproductive.
2. Temperature screening that misses many actually infected people can create a false sense of security, lulling people into complacent sloppiness about more effective measures such as social distancing.
3. The overinclusive nature of temperature checks will lead to real consequences for people — for example someone who may not be able to shop for groceries or use the metro to get to work despite the fact that they pose no public health risk. These consequences could be especially serious where temperature screening is used at essential facilities such as courthouses — and may be outsized for poor, minority, or other underserved communities who have fewer alternative options and less ability to seek redress.

It is for reasons such as these that many public health experts are dubious about the benefits of temperature screening. Prominent epidemiologist Michael Osterholm says, "I don't think airport temperature checks have any major effect on stopping or even slowing down transmission." The University of California San Francisco hospitals don't do temperature screening because the experts there found that the time and expense was unjustified and creates a false sense of security. "It's something we should not be doing," they declared. An expert analysis of existing studies likewise found that temperature screening programs "are ineffective for detecting infected persons."

Privacy issues

Temperature checks also raise privacy issues. In most circumstances, a remote temperature check is not an enormous invasion of privacy, especially if individual records are not retained — as they should not be outside of health care contexts. But neither is it something that we would ordinarily want companies or government agencies to routinely collect. And lurking in the wings behind remote temperature readings are technologies like remote detection of heart rate, breathing rate, and heart rate variability, which [studies](#) [have found](#) can all be measured using digital cameras (on still subjects, at least for now). There have even been preliminary results on the measurement of blood oxygenation. That kind of data is a significant privacy risk that [can reveal](#) a person's medical conditions, from detection of arrhythmias and cardiovascular disease, to asthma and respiratory failures, physiological abnormalities, psychiatric conditions, and even the stage of a woman's ovulation cycle.

Already, Draganfly [claims](#) that its COVID-detecting drone can remotely detect heart and respiratory rates in addition to temperature. The TSA has proposed collecting passengers' physiological data in the context of a program (now apparently stalled) called [FAST](#) (aka "Project Hostile Intent"), which aimed to detect terrorists by measuring every passenger's heart rate and body temperature as well as things such as eye movement and facial patterns.

In addition, with [so little](#) still known about the disease, it's possible scientists could conclude that other metabolic signs are equal to or better than temperature in flagging possible COVID-19 cases. For example, anecdotal [reports](#) suggest that "silent hypoxia" often accompanies COVID cases; that might lead to the screening of people's blood oxygen levels using oximeters. It has even been [suggested](#) that people be tested for their sense of smell.

This crisis threatens to normalize such physiological surveillance, with the result that even after a vaccine is distributed and COVID-19 retreats as a public health threat, new infrastructures for the routine and suspicionless collection of such data will remain. We don't want to wake up to a post-COVID world where companies and government agencies think they can gather temperature or other health data about people whenever they want. Before the outbreak, the Department of Homeland Security had already been [pushing](#) the use of thermal cameras as body scanners in transit stations as a way to try to detect threats such as suicide bombers — a constitutionally problematic and certainly ineffective program that would alert over all kinds of private items that people carry in their clothes. But it's not hard to imagine a network of thermal cameras created to fight the coronavirus repurposed for these suspicionless thermal body searches.

Some companies are betting on the technology outlasting the crisis; as one manufacturer [wrote](#), "We believe the demand for viable solutions like these will last far longer than most people think. Just like 9-11 and how it impacted and changed air-travel forever, this too will change the way we live and work for a long time to come."

That is precisely what we do *not* want to see.

Temperature checks as part of a disease surveillance effort

It is true that we may be facing a years-long battle to suppress the coronavirus before the advent of a vaccine, and efforts to quickly detect and quarantine COVID-19 cases could be crucial during that time. Such disease surveillance will be needed not only to save lives, but also to provide Americans with the widest possible freedom while they wait for a vaccine. The ideal way to track the disease would be through a fast, inexpensive, easy-to-administer, and widely available test for COVID-19.

Despite all of the technology's shortcomings, it's possible that some public health officials could judge that temperature screening is also worth doing in at least some contexts. Any such judgments should factor in the potential for significant or disparate disruptions in people's lives, for example by creating hour-long waits for transit stops in low-income neighborhoods. In addition, a lot of employers, stores, and other establishments will want to institute temperature screenings based either on similar judgments, out of a mistaken understanding of their effectiveness, or as a kind of "public health theater" meant to reassure customers who themselves hold such a misunderstanding.

Given the balance of factors involved, we do not think that "mass screening" thermal cameras should be used in any temperature screening. Even accurate temperature checks are of dubious usefulness in stopping the spread of the coronavirus. Among all means of trying to detect fever, remote detectors also appear to be the least accurate while at the same time the most likely to outlive the epidemic and end up being used for other purposes, like security screening, when COVID-19 is no longer a threat.

If public health experts decide that properly conducted temperature checks in certain appropriate times and locations would make sense as part of a disease surveillance effort, then that goal would be better served by deploying more accurate, direct detection devices such as clinical-grade tympanic thermometers. Any contact devices must of course be used in hygienic ways lest they spread the disease they are meant to stop. Thermometer guns and the best close-range, single-subject thermal cameras might also be used if their accuracy rates are found to be reasonable enough that their advantages over tympanic thermometers (speed and lack of direct contact) justify their use.

Like standoff detectors, such devices raise privacy issues because they gather people's physiological data, and they can be mildly more intrusive. Unlike a standoff sensor, more accurate devices have a low throughput rate and will require people to line up and actively participate in allowing their body to be physically measured. At the same time, they do not involve remote checks that can be done without a subject's knowledge, permission, or participation. For that reason, and precisely because they are slightly more intrusive and inconvenient, the use of more accurate devices is far less likely to outlast the pandemic.

Because they are less accurate, standoff fever detectors are also more likely to lead to discriminatory treatment for people of color and members of marginalized communities. What we have found with other imprecise technologies is that they tend to devolve into racial profiling in the hands of at least some of their operators. Examples include the TSA's SPOT program, and polygraphs, aka "lie detectors." This is because when risk-detection systems produce highly ambiguous or unreliable indicators, their operators begin filling that vacuum of reliability with their own judgments. Unreliable devices can also enable harassment or selective enforcement against people because of their appearance or political views.

One point that public health experts have long stressed is that voluntary measures to combat disease tend to be more effective than mandatory ones. This is because they leverage people's own incentives to report disease and receive help rather than creating an antagonistic relationship with the authorities that can spark resistance and evasion. For that reason, people should always have the right to leave rather than submit to a public temperature checkpoint. And employers and other establishments that want to perform temperature checks should consider offering self-serve temperature-checking facilities that allow employees to monitor themselves. People *want* to know if they may be sick; people *don't want* to spread a disease to their families or anyone else. And as we have seen, people who are antagonized by mandatory checks have many ways of intentionally defeating temperature screenings.

Finally, many people have fevers not related to infectious conditions. Some have low-grade fevers that may last weeks or longer, which can be caused by conditions such as cancer, urinary-tract infections, or even just stress. Where temperature screening is deployed, provisions will need to be made for them, especially if it is used at essential facilities. One thing that means is having a conversation with those who show up as positive, rather than summarily blocking them from entry. And anyone denied access to a critical service or function (such as applying for benefits, or appearing in court) because of a temperature screening should be given an alternate means of access to that service or function.

Summary of Recommendations

- Temperature screening should not be deployed unless public health experts say that it is a worthwhile measure notwithstanding the technology's problems. To the extent feasible, experts should gather data about the effectiveness of such checks, to determine if the tradeoffs are worth it.
- People should know when their temperature is going to be taken. Standoff thermal cameras should not be used.
- People should always have the right to leave rather than submit to a public temperature checkpoint.
- Personally identifiable data about individual readings should not be stored.
- No action concerning an individual should be taken based on a high reading from a remote temperature screening device unless it is confirmed by a reading from a

properly operated clinical-grade device, and provisions should be made for those with fevers not related to infectious illness.

- Anyone denied access to an essential service because of a temperature screening should be given an alternate means of access to that service.
- Hygienic self-serve or voluntary temperature-checking facilities are preferable to mandatory checks.

Conclusion

There's a lot of reason to doubt that temperature checks will help stop the spread of COVID-19, and they should not be deployed unless public health experts say conclusively that they will help. What we don't want is a world where inaccurate tests disrupt people's lives — especially those most vulnerable to such disruptions — waste time and other resources that could be better used in fighting the pandemic, and invade our privacy.

Cameron Chell, the CEO of drone company Draganfly, [told](#) a reporter, "Drones buzzing a few hundred feet away may seem intrusive, but it's certainly not as intrusive as having a line-up and someone sticking a sensor on your forehead." But how intrusive it *seems* is not as important as what data is collected about you, what is done with it, whether that data is accurate, and whether that data collection becomes permanent or even expands.

Many new products and approaches for combatting the coronavirus pandemic are being proposed. We need to skeptically scrutinize all such products and proposals, especially where they have implications for our privacy or other civil liberties. Temperature checks do have such implications, so they should be adopted only where their accuracy, and thus their benefits against COVID-19, are reasonably high, and where they are not likely to outlast the disease.

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