Infrared thermography for mass fever screening: repeating the mistakes of the past?

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On 31st December 2019, the local health authority in Wuhan, China issued an epidemiological alert over pneumonia cases of unknown cause, with many sharing a history of visiting Huanan seafood market. The causal viral infection was rapidly identified as a novel coronavirus, labelled 2019-nCoV. By 2nd January 2020, 41 identified cases had been hospitalised in China [1]. By 10th February 2020, 40,554 cases had been diagnosed globally, 40,235 alone on mainland China, with 319 confirmed cases in 24 other countries. The total associated death toll was 910 [2].

In an echo of the response to the SARS outbreak in 2002, public health officials have identified an urgent need to screen for respiratory infection at airports in order to limit the spread of the disease across regional and national borders. This is despite limited evidence that detection programmes affect public health outcomes in such population settings with very low disease incidence [3]. Fever has been, nonetheless, identified as a symptom at onset of illness in 98% of persons infected with 2019-nCoV [4]. On the assumption that at least some infected travellers would be febrile at the time of screening, several different types of infrared temperature measuring devices have been employed to identify an elevated facial temperature in those individuals. These are attractive as they are "non-contact" devices, so some distance is left between the subject and the operator. Infrared thermal imaging cameras, also technically known as screening thermographs [5] are, among experts, recognised as potentially the most reliable of these devices for use in fever screening. However, during the SARS outbreak, little was known about the most reliable measurement sites at the face, and most data were collected at the forehead, with little or no attempt to standardise image capture protocols. Consequently by 2013, Chan et. al. [6] had concluded forehead infrared thermography readings from a distance should be abandoned for fever screening.

Infrared thermal imaging cameras historically have been designed for use in industrial settings (for example identifying overheating electrical equipment, or for building inspection). Utilising such instrumentation in a medical context (potentially without the assurances provided by the EU's Medical Devices Directive, or FDA approval) is non-trivial. It was for this reason that in 2008 an ISO working group of international experts, led by the eminent Professor John Hedley-Whyte from Harvard University, and including two former presidents of the EAT and a former president of the American Academy of Thermology, published detailed guidelines for the deployment of screening thermographs for fever detection [5].

It is important to note that the ISO project did not seek to demonstrate that it was possible to detect fever using infrared thermography in a population setting; it merely sought to describe a rigorous method for performing measurements that would ensure valid, reproducible and traceable temperature measurements if such devices were to be used. As evidence, it drew on published research on thermography for fever detection in adults and children, the experience of metrologists regarding how to optimise thermograph performance, and considered the physiology of fever and the epidemiology of viral respiratory infections. The guidelines were updated in 2017 to include a revision of the normative references and bibliography, and to expand the applicability of the document from SARS screening to pandemic infectious diseases in general [7].

The recommendations of the ISO committee are well known in the thermology community. One key finding was that the inner canthus of the eye is the only site on the face suitable for fever detection. From basic inspection of the news footage coming out of the Far East over the last few weeks it is apparent that the ISO guidelines are being completely ignored in many cases [8]. The minimum recommended requirements that the subjects must be screened individually, facing the thermal camera, and with the face unobstructed by masks, spectacles or headwear, have simply not been implemented. Erroneously, thermal imaging equipment (some of it clearly badged as supplied by major international manufacturers) is being employed to screen large numbers of subjects in the same field of view. Faces are often obscured by masks, and there is frequently no attempt to isolate the inner canthus of the eye for specific measurement. Needless to say, the utility of such poorly-performed thermography for detecting febrile subjects is likely to be very limited indeed.

It is hard to understand whether this misuse of thermography arises from well-intentioned ignorance or wilful negligence. Either way, the result may be yet another missed opportunity to use modern technology to improve public health outcomes. The consequences are clear.

Although it is far from certain that thermography could ever be useful as a rapid mass-screening tool for fever detection, we will never know the answer to this unless measurements are performed to rigorous standards, and the outcomes - that is to say positive and negative predictive values - recorded and published for scientific scrutiny. Those that base their screening protocols on mere hearsay or dogma - be they users or manufacturers - should be challenged. It is the responsibility of every scientist and physician to base their practice on up-to-date evidence, whilst at the same time questioning that evidence in a systematic manner where appropriate.

We must seek to learn from this episode. The publication of authoritative guidelines or standards is not sufficient without strenuous educational efforts to ensure that they are widely employed. In this respect we feel it is important that greater effort be made to bring the ISO guidelines to the attention to those using infrared devices for fever screening. While the document is available to all, there is a charge for downloading it. This may have prevented wider dissemination of the content, although there are many references to the key findings published in the scientific literature. The challenges of fever screening and the ISO guidelines have been discussed by Francis Ring and others at sessions of the 11th, 13th and 14th Congresses of the EAT [9-11].

The European Association of Thermology can continue to play an important role. We must ensure that the best temperature science on this topic, often performed by our own members [12-17], is neither ignored nor misrepresented. We should encourage the dissemination of educational material through our journal, and engage with health professionals via our congresses, as well as with the public through the popular media. On the particular matter of fever screening, we must work with emergency preparedness teams to ensure the missteps of the past are not repeated. If the cost of accessing information is a barrier to good scientific practice, then much more consideration should be given to open access publishing [18].

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