



Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.



Letter to the Editor

Fever screening methods in public places during the COVID-19 pandemic



Sir,

The recent letter 'The non-contact handheld cutaneous infra-red thermometer for fever screening during the COVID-19 global emergency' expressed legitimate concerns about the accuracy of non-contact handheld infra-red thermometers for measuring temperature during the pandemic [1]. Non-contact handheld infra-red thermometers are indeed less accurate than tympanic thermometers and other infra-red thermal systems for the detection of fever [2]. In addition to the inadequacy of the equipment itself and the excessive distance between the thermometer and the skin [1], a worrying operator-dependent error exists. Although it is well known that handheld infra-red thermometers should be used to measure temperature at the temples or forehead, a large number of operators still use the forearm to save time and avoid close contact with the subject. The 'real' temperature of the human body is the core temperature, which is higher and more stable than the shell temperature [3,4]. The shell temperature, particularly skin temperature of the extremities, is vulnerable to the influence of environmental factors and thermoregulatory responses [4]. Therefore, measuring the temperature of forearm skin for the detection of fever is a colossal error.

Tympanic infra-red thermometers have been shown to correlate with core temperature, and are more accurate than infra-red skin thermometers [5]. However, it is not practical to use tympanic thermometers in places with high human flow. The probe of the tympanic thermometer should be inserted as deep as possible into the auditory meatus to get close to the tympanic membrane. Moreover, in order to avoid cross-infection, it is necessary to change the cover of the probe each time. These operations will increase the time taken to perform each measurement, resulting in queuing and clustering.

We strongly recommend the use of infra-red thermal imaging cameras at entrances to places with high pedestrian flow. Although thermal imagers only measure shell temperature, they have faster reaction speeds and a wider temperature acquisition area that avoids missing the potential hottest points of the body surface, such as the inner canthus of the eye [6]; as such, thermal imagers are more accurate than handheld infra-red thermometers [2,7]. If a person's temperature is

higher than the set point, an alarm will alert the staff to measure the individual's temperature more accurately [8]. In addition, the recording function also monitors if an operator has missed a person with suspicious body temperature.

During the COVID-19 global emergency, we propose a graded temperature measurement mode for the detection of fever: (1) infra-red thermal imaging cameras; (2) tympanic thermometers; and (3) sterilized thermometers for measuring axillary or rectal temperature. We recommend the use of infra-red thermal imaging cameras at the main entrances of hospitals, shopping malls, stations, airports, schools etc. for preliminary temperature measurements. Tympanic thermometers can be used in clinic rooms, aeroplanes, long-distance buses, hotels and classrooms to review temperature. Sterilized thermometers for axillary or rectal temperature are recommended in fever clinics, isolation wards, inpatient wards and for re-examination of cases of suspected fever.

Conflict of interest statement

None declared.

Funding sources

None.

References

- [1] Aw J. The non-contact handheld cutaneous infrared thermometer for fever screening during the COVID-19 global emergency. *J Hosp Infect* 2020;104:451.
- [2] Aggarwal N, Garg M, Dwarakanathan V, Gautam N, Kumar SS, Singh Jadon R, et al. Diagnostic accuracy of non-contact infrared thermometers and thermal scanners: a systematic review and meta-analysis. *J Travel Med* 2020;1:taaa193.
- [3] Guyton AC, Hall JE. Textbook of medical physiology. 13th ed. Philadelphia: WB Saunders; 2015.
- [4] Davis GR, Bellar D, Scott D, Laverne M. Effects of core temperature, skin temperature, and inter-beat interval on resting metabolic rate measurements in thermoneutral conditions. *J Therm Biol* 2019;85:102399.
- [5] Apa H, Gözmen S, Bayram N, Catkoğlu A, Devrim F, Karaarslan U, et al. Clinical accuracy of tympanic thermometer and noncontact infrared skin thermometer in pediatric practice: an alternative for axillary digital thermometer. *Pediatr Emerg Care* 2013;29:992–7.
- [6] Teunissen LP, Daanen HA. Infrared thermal imaging of the inner canthus of the eye as an estimator of body core temperature. *J Med Eng Technol* 2011;35:134–8.
- [7] Ng EY. Is thermal scanner losing its bite in mass screening of fever due to SARS? *Med Phys* 2005;32:93–7.
- [8] Ring EF, McEvoy H, Jung A, Zuber J, Machin G. New standards for devices used for the measurement of human body temperature. *J Med Eng Technol* 2010;34:249–53.

J. Zhang
S. Liu
B. Zhu*

*Department of General Surgery, Beijing Shijitan Hospital,
Capital Medical University, Peking University Ninth School of
Clinical Medicine, Beijing, China*

* Corresponding author. Address: Department of General
Surgery, Beijing Shijitan Hospital, 10 Tieyi Road, Yangfangdian
Street, Haidian District, Beijing 100038, China. Tel.: + 86
15301378617; fax: + 86 01063926164.
E-mail address: binbinzhu99@sohu.com (B. Zhu)

Available online 17 November 2020