

CCT TG Body Temperature Measurement

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Dolores del Campo

CCT WG NCTherm, TG BTM 20 October 2020

CCT TG Body Temperature Measurement

- The CCT President, and CCT Strategy WG, established a Task Group for body temperature measurement (TG BTM)
- TG under CCT WG for Non-Contact Thermometry
- The initial focus will be to improve non-contact body temperature measurement (ear, forehead, thermal imaging)

Purpose

- The task groups purpose is to establish reliable clinical thermometry on a global basis

New CCT task group on body temperature measurement

- Its objectives are:

- Lead a key comparison of calibrators for body temperature thermometers (ear/forehead/thermal imagers) – (Xiaofeng Lu, NIM, China)

- Collect and consolidate current best practice/standards of body temperature scanning in a) health services b) airport and other screening around the world (Igor Pusnik, UL, Slovenia)

- Collect current best practice of body temperature measurement and develop a definitive summary of the main body temperature measurement approaches (Maria-Jose Martin, CEM, Spain)

- Review standards and work with appropriate standardisation bodies (e.g. ISO/IEC) concerned with producing standards for body temperature measurement devices – (Wang Li, NMC A*Star, Singapore)

- The TG, in collaboration with the RMOs, will establish a forum of users and suppliers/manufacturers of body temperature measurement devices to identify the problems and develop practical solutions and establish appropriate links to the World Health Organisation – (Dolores del Campo, Euramet TCT Chair)

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- Actions to date:
- Agree groups initial terms of reference (12 June 2020)
- Hold inaugural meeting (7 July 2020)
- Establish four+one sub-Task Groups
- Progress review meeting with sub-TG chairs (18 Sep 2020)
- Report to CCT on progress (October 2020)

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- External engagement:

Invited keynote to APMP webinar “Challenges of use of IR in public health” July 2020

Publish letter Thermology International announcing TG

Machin, G., Lu, X., del Campo, D., Martin, M-J, Pusnik, I., Li, W., “**Letter: Global initiative to improve infra-red based body temperature measurements**”, *Thermology Int.*, **30**, p. 96, (2020)

Gave invited talk about the TG to UK Medicines and Healthcare products Regulatory Agency (MHRA) Sep 2020

Wrote guest editorial blog for European Association of Thermology website <http://www.eurothermology.org/news.html>

Questionnaire circulated to all RMO TCTs about current practice re body temperature measurement

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- Reports from sub-TG leaders



Key Comparison of BTM

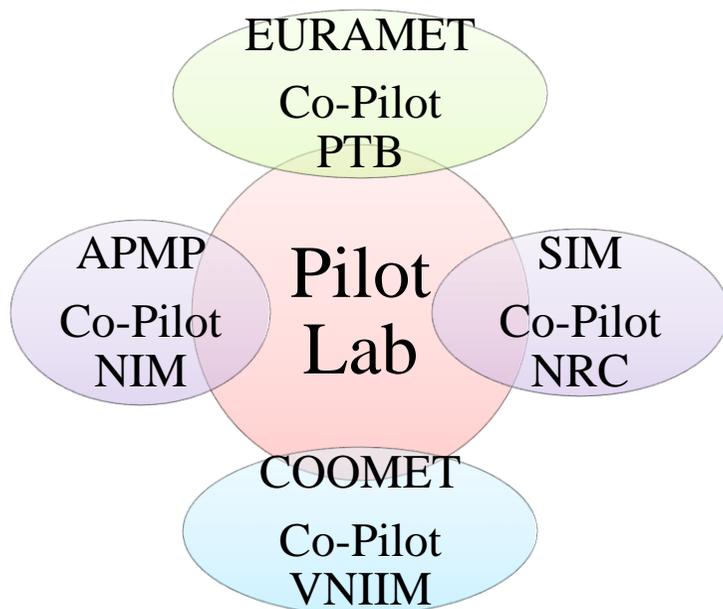
Scope: Comparison of radiance temperature scales for clinical infrared ear thermometers and forehead thermometer (35°C – 42°C)

Comparison Chain: STAR + Round-Robin

RMO Co-Pilot lab: EURAMET, SIM, APMP, COOMET...

Transfer artifact: Ear and forehead thermometer blackbodies

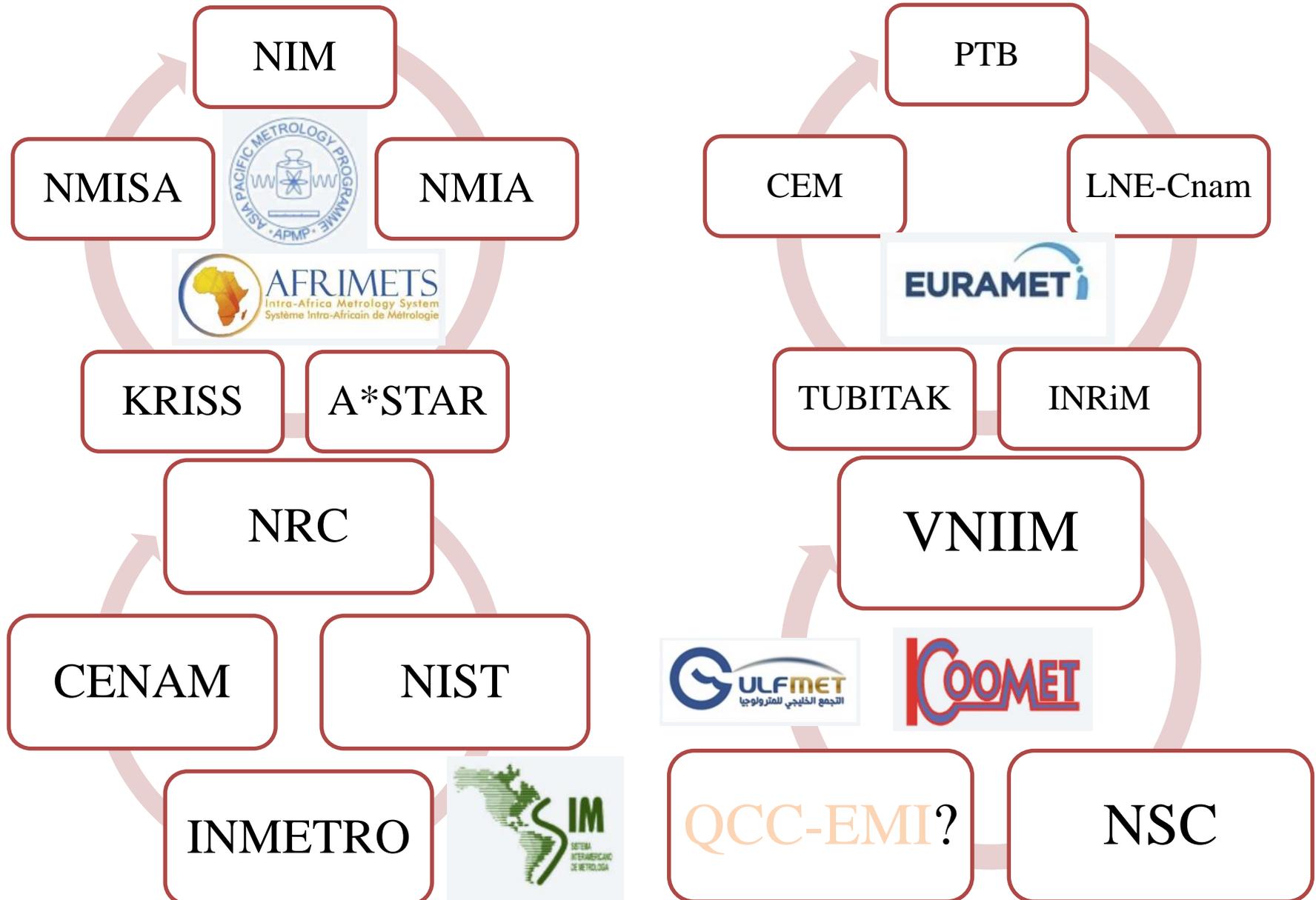
Participant: Participant NMIs measure the radiance temperature of the transfer blackbodies using their own infrared clinical thermometers with high resolution and good repeatability



NMI	Measurement period of plan
Co-Pilot	Oct. 2020 ~ Jan. 2021
Pilot	Feb. 2021 ~ May 2021
RMOs	Jun. 2021 ~ Mar. 2022
Pilot	Apr. 2022 ~ May 2022
Co-Pilot	Jun. 2022 ~ Jul. 2022



Participant NMIs





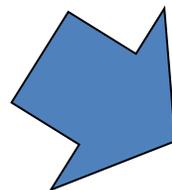
Sub-TG Tasks:

- Collect all the standards, best practice guides, regulations, health recommendations, documents and procedures → **done, main documents collected**
- Develop a practical guidance for ear and forehead radiation thermometers (IRET and IRFT): conditions of use and the uncertainties associated with them. The aim is to give to the interested community a comparative study (metrological/uncertainties) of the different equipment for measuring body temperature. → **in progress**
- Develop some simple presentations that could be used for training in use. It could be focused to not metrologist users.



Two drafted documents:

- **Best practice guide : use of ear radiation (or forehead) thermometers to perform traceable non-contact measurements of human body temperature** → 2nd draft circulating until the end of October in the sub-TG. Circulation in the whole TG in november



The uncertainty in use the most important contribution

1. Scope [-]

2. Objective

The objective of this document is to detail a series of good practices and operating procedures for the measurement of human body temperature by using the thermometers mentioned in the scope, in order to detect, with the highest possible reliability, people with a body temperature compatible with the symptoms of COVID-19, or for a similar purpose in any other health emergency.

3. Introduction [-]

4. Principle of measurement of infrared ear thermometers [-]

5. Basic operating instructions [-]

6. Measurement influence quantities and uncertainties associated [-]

The accuracy of the infrared ear thermometers depends on its capacity to determine the internal body temperature, the accuracy of the thermometer per se and the uncertainty when in use.

Capacity to determine the internal body temperature [-]

Accuracy of the thermometer [-]

The standard IEC TS 62493-1:2008 "Industrial process control devices - Radiation thermometers - Part 1: Technical data for radiation thermometers [-]

Uncertainty in use

IRET: resolution, repeatability, misalignment, ambient conditions, dirt in the ear canal, influence of the probe cover, heating of the thermometer when held in the hand and drift [-]

IRFT: resolution, repeatability, size of source effect (SSE), distance effect, ambient conditions, emissivity, influence of cover, heating of the thermometer when held in the hand, homogeneity of the measured area, and drift [-]

Uncertainty budget [-]

7. REFERENCES [-]

ANNEX. Mathematical model and uncertainty calculation [-]

“body temperature scanning” group timetable of activities

- Establishing the group of active members (by the end of September 15 members volunteered)
- Distribution of the draft protocol (prepared by Igor Pušnik, sent to active members for discussion)
- Gathering the protocols for entry points in countries and healthcare units (by the end of November)
- Analysis of the protocol (by the end of 2020)
- Final version of the protocol and report to the CCT (by April 2021)
- Proposal of further research relevant for support of scanning protocols (by April 2021)

Discussion and objectives

- In the light of recent pandemic it seems that technologies for non-contact body temperature measurement, although relatively simple and easy to use from users perspective, represent a great challenge also to temperature experts which have to provide:
 - metrological traceability of measuring instruments
 - and relevant guidance how to use various instruments in order to provide **accurate, reliable and traceable** results.

SUB-TG: LIAISON WITH STANDARDIZATION BODIES CONCERNED WITH PRODUCING STANDARDS FOR BODY TEMPERATURE MEASUREMENT DEVICES

Wang Li

Principal Research Officer

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15 June 2023



Works done

- Studied the current standard ISO 80601-2-56:2017 on clinical thermometers:
- Gaps have been analyzed preliminarily
 - There is no differentiation between ear thermometer and forehead thermometer
 - There is no standard on the correlation between the forehead skin and the body core temperatures and the correlation is very much established by each manufactory itself
 - There is no requirement on study of the physiological effects on the forehead skin temperature such as effect from environmental conditions and the defined environmental conditions in the standard are for equipment only
- Successfully joined ISO/IEC WG on clinical thermometer as Singapore representative (ISO/TC 121/SC 3/JWG 8 or IEC-TC 62/SC 62D/JWG 8) and will join the next meeting on 16 Oct 2020

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- Dolores del Campo (CEM)
“establish a (RMO) forum of users and suppliers/manufacturers”

First step – engage community through questionnaire



Why?

The Covid-19 crisis (and previous virus outbreaks) has brought into the spotlight how unreliable body temperature measurement can be in health services and more generally around the world. In addition, poor body temperature measurements are suspected of fuelling antibiotic resistance and increasing avoidable deaths and therefore the problem has to be addressed as a matter of urgency. The reasons why this issue has arisen are complex but are thought to have their origins in the replacement of mercury-in-glass clinical thermometers, which were well understood with low uncertainties, by a range of different thermometer modalities and body temperature measurement sites.

Purpose

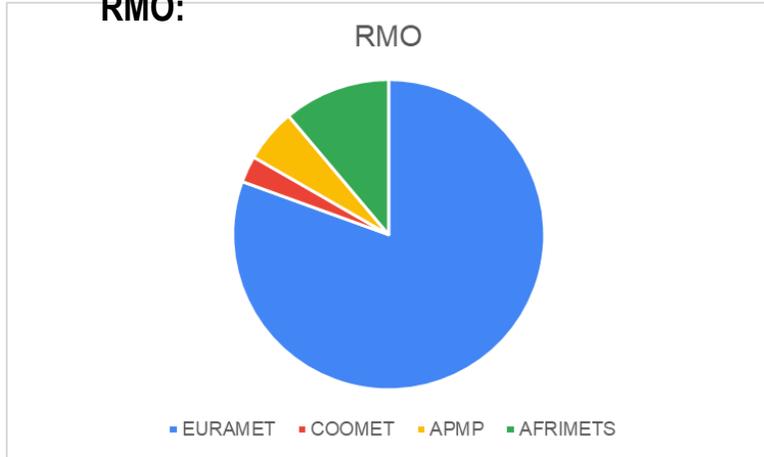
The purpose of the task group is to establish reliable clinical thermometry on a global basis. Its initial focus will be infra-red approaches; tympanic and skin (e.g. forehead/thermal imaging). One of the main objectives of the group is to collect and consolidate current best practice and standards for body temperature measurement. This information will be used to develop definitive guidance for body temperature measurement, including a statement of likely uncertainties and the advantages and disadvantages of the different methods.

The task group plans to collaborate with the appropriate standardisation bodies responsible for development of standards for body temperature measurement devices. More information about the task group's work can be found at: Machin, G., *et al*, "Letter: Global initiative to improve infra-red based body temperature measurements", *Thermology Int.*, **30**, p. 96, (2020)

If you are a manufacturer, supplier or user of instrumentation for body temperature measurement, we will appreciate your participation in our stakeholder's forum and replying to this questionnaire: [GO TO QUESTIONNAIRE](#).

PRELIMINARY RESULTS OF THE SURVEY ABOUT BODY TEMPERATURE MEASUREMENTS

Profile of the respondents by RMO:

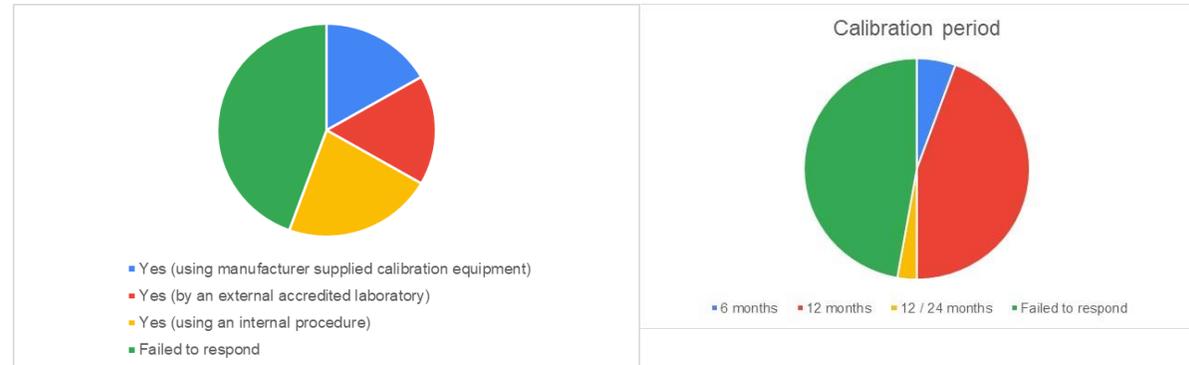


Most of the respondents are interested in take part in the stakeholder's forum:

International standards mentioned by the manufacturers:

- MI 3556-2009
- ISO 17025 / CE / FCC
- CNS,ASTM,EN

Performance of the periodical calibrations:



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- Next steps to end 2021
- Prepare advanced drafts of GPGs ear, forehead, thermal imaging by end of 2020
- Elicit comments on GPG from relevant medical community
- Prepare one-page GPGs for clinical use, with estimates of uncertainty
- Prepare final versions of GPG to encompass all three modalities
- Grow engagement with standards committees – TG members please join (WL)
- Initiate KC of ear thermometer calibrators