Sustainable Hospitals Program
A Project of the Lowell Center for Sustainable Production, University of Massachusetts Lowell

Selecting Non-Mercury Thermometers

Alternatives to glass/mercury thermometers are quite appealing as they are easier and faster to use and avoid the shortcomings of glass/mercury thermometers. The risks of broken glass and exposure to mercury are eliminated, as well as the cost of a clean-up and disposal of mercury from a broken thermometer. With the variety of alternatives available, it is essential that one make an educated choice to ensure that the tool satisfies the task. Here are some points worth thinking about when you consider thermometers:

1. Acceptable standards of accuracy

Thermometers for medical use are typically tested to voluntary standards set by the American Society of Testing and Materials[1] (ASTM). The following table shows the maximum error allowed. One sees that glass/mercury and electronic thermometers have the same requirements over the range of 96.4 - 106 F.

		Maximum Error over Temperature Range Shown				
Thermometer Type	*ASTM Procedure[1]*					
Fahrenheit Scale:		***<96.4 °F***	***96.4 to < 98.0 °F***	***98.0 to 102.0 °F***	***>102 to 106 °F***	***>106 °F***
Mercury in Glass	E667	± 0.4 °F	± 0.3 °F	± 0.2 °F	± 0.3 °F	± 0.4 °F
Electronic Thermometers	E1112	± 0.5 °F	± 0.3 °F	± 0.2 °F	± 0.3 °F	± 0.5 °F
Celsius Scale:		***<35.8 °C***	***35.8 °C to < 37 °C***	***37.0 °C to 39.0 °C***	***>39.0 °C to 41.0 °C***	***>41.0 °C***
Mercury in Glass	E667	± 0.3 °C	± 0.2 °C	± 0.1 °C	± 0.2 °C	± 0.3 °C
Electronic Thermometers	E1112	± 0.3 °C	± 0.2 °C	± 0.1 °C	± 0.2 °C	± 0.3 °C

It is important to note that many thermometers read out to a smaller division than the accuracy of the thermometer itself. For example, digital thermometers which read to 0.1 degrees F may be accurate only to ± 0.2 F or less. If the accuracy is ± 0.2 degrees F, the true temperature of a thermometer reading 98.9 F is in the range of 98.7 – 99.1 degrees Fahrenheit. Therefore when selecting a thermometer, one must look closely at the accuracy, rather than the smallest increment reported.

2. Accuracy of glass/mercury thermometers

Inherent in any discussion of alternatives is the assumption that glass/mercury thermometers are accurate. Data suggest that our faith in glass/mercury thermometers may be misplaced.

Leick-Rude and Bloom[2] describe a study in which axillary temperature in neonates was taken with non-mercury thermometers and compared with a "standard" of glass/mercury thermometers. For the purpose of the study, the accuracy of each glass/mercury thermometer was tested as a condition of accepting it for the study. 25% of the glass/mercury thermometers tested differed from the reference thermometer by ≥0.2 degrees Centigrade and were deemed unacceptable for use in the study. The authors cite another study in which 28% of glass/mercury thermometers

were discarded because they differed by more than 0.1 degree Centigrade from the reference thermometer. The authors raise concern as to the accuracy of glass/mercury thermometers for general use, when one out of four of those tested was not deemed accurate enough. (In fact, the ASTM standard for glass/mercury medical thermometers specifies a maximum allowable error of ± 0.1 C in the cited range).

3. Favoring the old standard

Chamberlain and Terndrup[3] remind us that "Whenever a new clinical test is introduced, investigators measure its accuracy by comparing it to an accepted standard, termed the 'gold standard'. Because of this comparison to the old standard, initial testing will, by definition, favor the old method, even if the new clinical test is a better test".

4. Use of rectal, oral, or axillary readings as a reference for tympanic temperature

The publication *The Clinical Utility of Ear Thermometers*[4] describes different methods and their limitations for measuring body temperature. It cites that the medically accepted "gold standard" for core temperature is pulmonary artery blood temperature. However this is an invasive technique, so rectal, oral, or axillary readings are often used as a crude estimate of body core temperature. Each site is reflective of a different blood supply, with separate rates of change with a rising or falling body temperature. Additionally, each site has variables unique to that site that influence the body temperature measured. The publication concludes that since each site provides its own characteristic temperature properties, comparing a tympanic temperature directly with oral, axillary, or rectal temperatures is inherently flawed.

The lesson here is that with an understanding of how alternative thermometers work, they may offer a safe, convenient alternative to traditional oral, axillary, or rectal temperature measurement using a mercury in glass thermometer. Education is critical to satisfactory performance, and manufacturers are well prepared to advise and coach clinicians on the use of their products.

5. Customer Satisfaction

Numerous interviews with users of non-mercury thermometers provide convincing evidence that alternatives are viable and well-received in health care facilities. For more information on mercury and on product alternatives, visit the SHP website at *http://www.sustainablehospitals.org* or contact us at *SHP@uml.edu* or (978) 934-3386.

References
1) American Society of Testing and Materials (ASTM), www.astm.org, West Conshohocken, PA
2) MK Leick-Rude and Bloom LF, "A comparison of temperature-taking methods in neonates", *Neonatal Network;* August, 1998, Volume 17 No. 5, pp. 21-37
3) James M. Chamberlain, MD, and Thomas E. Terndrup, MD, "New light on ear thermometer readings" *Contemporary Pediatrics;* March, 1994.
4) *The Clinical Utility of Ear Thermometers*, Published by Braun Thermoscan, Pub. No. 0996-267P-R1097

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