BRIEF

Temperature Measurement in a Clinical Setting

KATHLEEN M. TAKACS • WILLIAM M. VALENTI

The measurement of body temperature is the most frequently performed nursing task in the modern hospital and a variety of thermometer systems are available. Accuracy, ease of use, time required for temperature measurement, and cost determine which thermometer system is used. This investigation studies the factors associated with temperature measurement in a clinical setting, including the time for temperature measurement, type and order of nursing tasks, and adherence to established protocols.

Method

Four different thermometer systems were used. They were the standard mercury-in-glass system (Faichney® [1]), a modification of the glass system which uses a soft, flexible plastic sheath over the thermometer (B-D Temp-Away, Single Use Thermometer Sheath® [2] and SteriTemp Thermometer Sheath® [3]), and two electronic systems (IVAC 821® and IVAC 829® [4]). Seven study units (general medicine, adolescent pediatrics, general surgery, obstetrics, medical intensive care, surgical intensive care, and pediatric intensive care units) were chosen from the 26 inpatient units as representative patient units.

The standard mercury-in-glass dry kit system has been used at the hospital for many years. The other systems were introduced to the study units on a rotating basis and used for approximately six weeks each. An educational program for nursing staff on all three shifts was conducted on the study units to orient nursing staff to the study and to various thermometer systems. These programs were presented by the project nurse and an instructor from the hospital's staff development program. The purposes and methods of the study were reviewed with nursing staff on the study units on all three shifts. The inservice program consisted of a brief review of each system according to the manufacturer's instructions. Nurses were instructed to use glass thermometers as they ordinarily did, without varying the time normally used for temperature measurement or the pattern of their activities during the temperature measurement process. After introduction and inservice, each new system was used on each study unit seven to ten days prior to actual observation.

After this practice week, the temperature measurement process was observed by an investigator or one of three trained student assistants. Observations were made on all three shifts in proportion to the total number of temperatures measured per shift. Each observer stood in the patient's room and observed the entire temperature measurement process from the time the staff nurse entered the room until the nurse left the room or engaged in acitivity not related to measurement of vital signs. The temperature was timed using a stopwatch. All data were recorded. Tabulation and statistical analysis of data were done using the IBM 360/60® computer.

Results

During the 12-month study period, 1,246 observations were made. Because of invalid times and interruptions while preparing the thermometer for use, a total of 1,080 observations were considered for timing of the temperature measurement process. The mean cumulative times for temperature measurement with unsheathed glass and sheathed glass measurement times were similar for both oral and rectal temperature measurements ranging from 3 minutes 18 seconds to 4 minutes.

The largest portion of this cumulative time was the time for temperature measurement itself. A wide range of times for temperature measurement was noted, from 42 seconds to 9 minutes 30 seconds with un-

[1]Manufactured by Cheesbrough Ponds Inc., Greenwich, Connecticut.
[2]Manufactured by Becton-Dickenson, Rutherford, New Jersey.
[3]Manufactured by Steridyne Corporation, Riviera Beach, Florida.
[4]Manufactured by IVAC Corporation, San Diego, California.

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sheathed glass and 54 seconds to 6 minutes 36 seconds with sheathed glass. The mean times that thermometers were left in place for each temperature site and thermometer system are shown in Table 1. Both glass systems generally were left in place for the same length of time when used orally. Glass rectal thermometers tended to be left in place for slightly longer times than oral thermometers. The difference in placement times for unsheathed and sheathed rectal thermometers is not clinically significant. Preparing the thermometer for use and preparing for storage after temperature measurement did not add significantly to the overall time for the temperature measurement process.

Mean cumulative times for oral and rectal electronic measurements were shorter, ranging from 1 minute to 1 minute 24 seconds. Temperature measurement times with electronic thermometers were shorter than with either glass system for both oral and rectal temperatures and ranged from 42 to 48 seconds (Table 1). Narrower ranges for minimum and maximum placement times, from 20 seconds to 3 minutes 12 seconds were noted with electronics.

In general, the temperature measurement process for glass systems began immediately without prior cleaning of the thermometer. Unsheathed glass thermometers were more likely to be cleaned before or after use than sheathed glass thermometers. When cleaning of thermometers was analyzed by site of temperature measurement, more rectal thermometers were cleaned either before or after use than oral thermometers. While 92 (56.4 percent) of 163 sheathed and unsheathed rectal thermometers were cleaned before or after use, only 56 (11.2 percent) of 503 sheathed and unsheathed oral thermometers were cleaned before or after use.

Nursing tasks were performed as part of the temperature measurement process in 1,246 observations (Table 2). Nurses were more likely to leave the room during temperature measurement itself when using either glass system than with electronics. This difference is statistically significant (chi-square method, $p < .001$). Nurses also performed various room tasks more frequently (charting, monitoring of intake and output, and miscellaneous room tasks) during temperature measurement with either glass system than with the electronic thermometers ($p < .001$).

When using sheathed or unsheathed glass thermometers, pulse and/or blood pressure were measured during temperature measurement on all but two occasions. When electronic thermometers were used, virtually all vital signs measurements were taken after the electronic probe cover had been discarded and temperature measurement had been completed. When using electronic thermometers, vital signs of any type were taken during more than 90 percent of the observations. When analyzed statistically, vital signs were more likely to be taken with either electronic system than with either glass system ($p < .001$). Using the same tests of significance, complete vital signs (i.e., pulse and blood pressure measurements together) were more likely to be taken with electronic thermometers than with glass ($p < .001$).

Table 1. Mean Thermometer Placement Time for Oral, Rectal, and Axillary Temperature Measurements with Four Thermometer Systems

Temperature Measurement Site	Unsheathed Aver. Time	Glass Observ.	Sheathed Aver. Time	Glass Observ.	Electronic 1 Aver. Time	Electronic 1 Observ.	Electronic 2 Aver. Time	Electronic 2 Observ.	Total
Oral, Mean Time	2 min. 54 sec.	193	2 min. 48 sec.	276	45 sec.	258	42 sec.	116	843
Rectal, Mean Time	3 min. 36 sec.	102	3 min. 6 sec.	52	48 sec.	49	48 sec.	18	221
Axillary, Mean Time	6 min. 18 sec.	9	3 min. 48 sec.	1	42 sec.	1	60 sec.	5	16
Total		304		329		308		139	1,080

Table 2. Summary of Nursing Tasks During 1,246 Observations

		Unsheathed $N=328$	Sheathed $N=351$	Electronic 1 $N=408$	Electronic 2 $N=159$
Nurse Leaves Room		199	265	53	13
(% of total per system)		60.7	75.5	13.0	8.2
Performs Room Tasks		136	134	6	4
(% of total per system)		41.5	38.2	1.4	2.5
Vital Signs					
Pulse only		31	24	12	3
	%	9.5	6.8	2.9	1.9
Blood pressure only		16	35	10	2
	%	4.9	10	2.5	1.3
Pulse and blood pressure together		182	231	379	136
	%	55.8	65.8	92.9	85.6
Any vital signs		229	288	395	147
	%	69.8	82.0	96.8	92.5

Of the 1,235 observations for which data on site of temperature measurement were available, the distribution of oral and rectal measurements was similar for the glass systems combined and for the electronic systems combined. When all glass measurements were compared to electronic measurements, significantly more rectal temperatures were taken with glass thermometers (163 of 676; 24.1 percent) than with electronics (75 of 554; 13.6 percent) ($p < .001$).

Discussion

The temperature measurement process was observed for a year. Nurses appeared to use all the time available during the temperature measurement process. Temperature measurements with glass thermometers were integrated into the nurses' overall work routine. The time for temperature measurement seemed to be determined by the number of other nursing duties that were done, not by established protocol. When glass thermometers were used, most nurses

left the room to perform other duties and returned after a period of time to read the thermometer or they performed other room tasks in that room. None of the nurses merely stood at the patient's bedside while waiting for glass thermometers to register. Recommendations exist for duration of placement of glass thermometers (Nichols and Kucha, 1972) but their end point for temperature measurement is not as well defined as with electronic thermometers.

When using glass thermometers, sufficient time for temperature measurement may be a function of the amount of time available and number of other duties required. There were wide variations in thermometer placement time with the mean time for glass measurements of only two to three minutes. Some of these times were as short as 30 seconds, which seems inadequate for temperature measurement. When using electronic thermometers, nurses rarely left the room during temperature measurement.

Most electronic thermometers register temperatures by predicting final temperature through calculations based on rate of temperature rise over time and such temperature measurements are typically much faster than glass. Electronic thermometers have a visible endpoint with a flashing light or audible tone, which may also explain why nurses remain in the patient's room when using electronic thermometers.

The measurement of pulse and blood pressure may also be a function of the amount of time necessary to measure temperatures with glass vs. electronic thermometers. When less time is required for temperature measurement with electronic thermometers, pulse and blood pressure measurements appeared to be measured routinely. This may be because productivity is increased as the result of the shorter time for temperature measurement with electronic thermometers.

It is unclear why the number of rectal temperatures measured with electronic thermometers decreased. Possibilities include better patient compliance for oral temperatures with electronics, since less time is required for temperature measurement. The fact that electronic temperatures may be measured with the patient's mouth opened may be a contributing factor.

The risk of cross-contamination with glass thermometers has not been documented and outbreaks of nosocomial infection have never been traced to thermometers (U.S. Center for Disease Control, 1978). Poorly cleaned thermometers, particularly those used for rectal temperatures, may play a role in cross-colonization of patients via the hands of personnel.

Thermometer cleaning is essential after use of soft plastic sheaths because of the possibility of sheath perforation (Valenti and Takacs, 1981). Cleaning the thermometer and careful handwashing after use are basic nursing practices that should be emphasized whenever glass thermometers are used.

It appears that temperature measurement is carefully incorporated into other aspects of nursing care. However, the order and performance of nursing tasks may be integrated into the temperature measurement process depending on the thermometer system used. The shortened times for temperature measurement with glass thermometers in our study may be a function of demands on nursing time. The wide variability in the times over which glass thermometers were left in place affect the reliability of some of these temperature measurements and have implications for patient management.

Electronic thermometers may present a distinct advantage over glass systems. The shorter placement time for electronic thermometers may allow more time for nurse-patient communication and result in increased patient safety and comfort. This may be especially relevant in acute care settings, intensive care units, and emergency rooms, where demands on nursing time are most crucial. NR

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