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Original Article

Emergency department rectal temperatures in over 10 years: A retrospective observational study

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BACKGROUND: Fever in patients can provide an important clue to the etiology of a patient's symptoms. Non-invasive temperature sites (oral, axillary, temporal) may be insensitive due to a variety of factors. This has not been well studied in adult emergency department patients. To determine whether emergency department triage temperatures detected fever adequately when compared to a rectal temperature.

METHODS: A retrospective chart review was made of 27 130 adult patients in a high volume, urban emergency department over an eight-year period who received first a non-rectal triage temperature and then a subsequent rectal temperature.

RESULTS: The mean difference in temperatures between the initial temperature and the rectal temperature was 1.3 °F (P<0.001), with 25.9% of the patients having higher rectal temperatures ≥2 °F, and 5.0% having higher rectal temperatures ≥4 °F. The mean difference among the patients who received oral, axillary, and temporal temperatures was 1.2 °F (P<0.001), 1.8 °F (P<0.001), and 1.2 °F (P<0.001) respectively. About 18.1% of the patients were initially afebrile and found to be febrile by rectal temperature, with an average difference of 2.5 °F (P<0.001). These patients had a higher rate of admission (61.4%, P<0.005), and were more likely to be admitted to the hospital for a higher level of care, such as an intensive care unit, when compared with the full cohort (12.5% vs. 5.8%, P<0.005).

CONCLUSIONS: There are significant differences between rectal temperatures and non-invasive triage temperatures in this emergency department cohort. In almost one in five patients, fever was missed by triage temperature.

KEY WORDS: Rectal temperatures; Oral temperatures; Axillary temperatures; Emergency department

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INTRODUCTION

Fever is important in the undifferentiated patient with a new complaint, as it frequently suggests an infectious etiology or other dangerous pathology. Sites for temperature assessment have many unique advantages and disadvantages.[1] Multiple studies suggest that while rectal temperatures correlate well with true "core" body temperature, as measured by pulmonary artery catheter, other less-invasive sites may not always be accurate.[2–8] This is especially true in the emergency department (ED), where patients seeking medical attention may have had recent exposure to cigarette smoking, cold or hot beverages, or extreme weather conditions. While oral, axillary, or temporal thermometers are frequently used

to triage adult patients in emergency departments, it is anecdotally noted by many emergency physicians that patients may register as afebrile with the former methods, while a more invasive rectal temperature may detect the patient's fever (if one exists). This is especially important if the temperature would change clinical management. For example, 83% of patients in a multi-center study of patients with confirmed sepsis had a temperature abnormality of fever or hypothermia.[9]

Surprisingly, few studies have evaluated adult ED patients for fever by temperature site. For this reason, we chose to investigate whether less-invasive triage temperature measurements (oral, temporal, axillary) are accurate for the detection of fever (defined as ≥100.4 °F, ≥38.0 °C) as compared with rectal temperature measurements in adult patients undergoing evaluation in a high volume, urban ED over an 8-year period.

METHODS

We performed a retrospective electronic chart review of all patients who received a rectal temperature during their ED stay between the dates of January 1, 2002 through February 28, 2011. The institutional review board of the St Luke's-Roosevelt Hospital Center of Columbia University reviewed, approved and qualified the study protocol as exempt from further review.

The study institution is an urban, academic center with an annual ED census of approximately 110 000 patients. We included all adult patients over the age of 18 who received a rectal temperature while in the ED from January 1, 2002 through February 28, 2011. We excluded patients under the age of 18 because children routinely receive rectal temperatures as their initial temperature. To collect the raw data, departmental informatics specialists queried our electronic medical record database using a structured search designed to detect all patients over the age of 18 who received a rectal temperature during the study period. Specific data elements included many aspects of the patient's medical record (e.g. age, sex, initial temperature source, initial temperature, rectal temperature). The raw data were provided as a spreadsheet document in aggregate.

Two physician abstracters (D.R. and G.W.) extracted data using formatted data sheets. Both are emergency medicine residents trained by the principle investigator (J.L.) in training sessions designed for the protocol. Specific elements abstracted included age, gender, initial temperature source (oral, rectal, temporal, axillary), initial temperature, rectal temperature, door-to-rectal temperature time, initial temperature-to-rectal temperature time, antipyretics given (acetaminophen, acetaminophen and codeine, ibuprofen, ketorolac), and time to antipyretic treatment. All patients who had an initial rectal temperature were excluded from the analysis (n=20 045). In our institution, an initial rectal temperature often suggests a critically ill medical or trauma patient requiring immediate resuscitation, or an altered or combative who cannot or will not cooperate with a standard oral, axillary, or temporal measurement. Additionally, another 120 (0.44%) patients were removed because of an error in documentation of the temperature. The data were then grouped by initial temperature source: oral, axillary, and temporal.

Our primary outcome measure was the temperature difference between an initial non-invasive temperature measurement at triage and a subsequent rectal temperature. As secondary outcomes, we examined the disposition (discharge home, admission to the hospital, admission to the intensive care unit (ICU)/operating room (OR), expired, other), average heart rates, average respiratory rates, and use of antipyretics. Additionally, we evaluated these variables by initial temperature source (oral, axillary, temporal). We also looked specifically at the cohort of patients who were afebrile by initial temperature, but were found to be subsequently febrile by a rectal temperature.

In addition to standard descriptive statistical methods, we performed t-tests to determine statistical significance between two continuous variables and the Pearson's product-moment correlation coefficient analysis and the Chi-square test to determine statistical significance between proportions. We analyzed the data using Microsoft Excel 2011 (Microsoft Corp., Redmond, WA) and SPSS 13.0 (SPSS Inc., Chicago, IL). Statistical significance was set at 0.05 and confidence intervals were set at 95%.

All oral, axillary, and rectal temperatures were measured using either the reusable Alaris IVAC Turbo Temp 2185BXO1E or Alaris IVAC TempPlus II 2080 Electronic Thermometer (CareFusion, San Diego, CA), which have a temperature recording range of 80.0 °F to 108.0 °F and use disposable plastic sheaths over the actual probes. The Exergen Temporal Scanner TAT-5000 (Exergen Corporation, Watertown, MA) was used for all temporal artery temperature measurements, with a range of 60.0 °F to 107.6 °F.

RESULTS

A total of 27 130 patients met the inclusion criteria for the study, with 6 668 (24.6%) being febrile defined

either initially or by subsequent rectal temperature. The mean age of the study population was 57.7 years, with the majority being female (59.3%). In terms of disposition, 14 457 (53.3%) patients were admitted to inpatient floor services, with another 1 575 (5.8%) patients admitted to a higher level of care beyond the regular inpatient floor (ICU or OR) (Table 1).

In our study the average triage and rectal temperatures were 98.2 °F and 99.5 °F, respectively. This represents a statistically significant temperature difference of 1.3 °F (P<0.001). A total of 706 (2.6%) patients had the same temperature in triage and rectally, 7 025 (25.9%) patients had a rectal temperature higher than and equal to 2 °F, 1 344 (5.0%) patients had a rectal temperature higher than and equal to 4 °F, and 243 (0.9%) had a rectal temperature higher than and equal to 6 °F. In our cohort, a small percentage of patients received an antipyretic before rectal temperature measurement (n=2 829, 7.6%) (Table 2).

The majority of triage temperatures were taken by the oral route (n=25 513, 94.1%), with a smaller number by axillary (n=634, 2.3%) and temporal (n=983, 3.6%) routes (Table 3). When comparing oral temperatures with rectal temperatures, the rectal temperature was on average 1.2 °F higher (P<0.001) and in 81.6% of the time, the rectal temperature was higher than the oral temperature. For axillary temperatures, the rectal temperature was on average 1.8 °F higher (P<0.001) and in 65.5% of the time the rectal temperature was the higher temperature. Similarly, for temporal temperatures, the rectal temperature was on average 1.2 °F higher (P<0.001) and in 77.7% of the time the rectal temperature was higher than the temporal temperature.

In the patients who were febrile determined by rectal temperature but afebrile initially by their triage-documented temperature (n=5 093, 18.8%), there was an average 2.5-degree difference between the triage and rectal temperatures (98.9 °F vs. 101.3 °F, P<0.001) (Table 4). When examined by the route that the temperature was taken, the mean differences between the initial temperature and rectal temperature were 2.4 °F, 3.0 °F, and 3.0 °F for oral, temporal and axillary routes respectively. On average, these patients were mildly tachycardic at 101.2 beats per minute. When compared with the full cohort, these patients were more likely to

Table 1. Characteristics of patients included in the study

Parameters	*n* (%)
Age (years)	
18–30	3 512 (12.9)
31–40	2 976 (11.0)
41–50	4 282 (15.8)
51–60	3 805 (14.0)
61–70	3 695 (13.6)
71–80	4 139 (15.3)
81–90	3 594 (13.2)
91+	1 127 (4.2)
Gender	
Female	16 085 (59.3)
Male	11 044 (40.7)
Disposition	
ICU / OR	1 575 (5.8)
Inpatient Admission	14 457 (53.3)
Discharge	10 647 (39.2)
Eloped/AMA	398 (1.5)
Expired	53 (0.2)

Table 2. Vital signs, times and antipyretic usage in the study population

Variables	Results
Initial triage non-rectal temperature (°F)	98.3 (98.2±1.7); range: 80–107.6
Rectal temperature (°F)	99.4 (99.5±1.6); range: 82.7–108
Difference (°F)	1.3 (–10.3 to 18.6), P<0.001
Pulse (beats per minute)	93 (24–275)
Respiratory rate (breaths per minute)	19.3 (6–68)
Initial temperature to rectal temperature time (minutes)	119.3 (0–3 032)
Patients febrile (n, %)	6 668 (24.6)
Patients receiving antipyretic before rectal temperature (n, %)	2 070 (7.6)

Table 3. Vital signs, times and antipyretic usage in the study population by route of triage temperature

Variables	Oral	Axillary	Temporal
Patients (n, %)	25 558 (94.1)	638 (2.3)	988 (3.6)
Initial temperature (°F)	98.3 (98.3±1.7); range: 80–107.6	97.8 (98.0 ±2.1); Range: 90–106.7	98.0 (98.1±1.6); Range: 80–106.6
Rectal temperature (°F)	99.4 (99.5±1.5); Range: 82.7–108	99.6 (99.8±2.0); Range: 88.8–106.0	99.2 (99.3±1.9); Range: 89.1–105
Difference (°F)	1.2 (–10.3 to 18.6), P<0.001	1.8 (–7.2 to 9.2), P<0.001	1.2 (–7.9 to 13.1), P<0.001
Pulse (beats per minute)	92.3 (24–275)	98.9 (42–189)	93.3 (30–175)
Respirations (breaths per minute)	19.2 (6–68)	23.6 (12–60)	19.9 (10–56)
Initial to rectal temperature time (minutes)	118.8 (0–3 032)	113.9 (10–1 464)	135.5 (1–1 641)
Initial temperature to antipyretic time (minutes)	136.6 (0–1 936)	117.5 (0–829)	176.3 (0–1 651)
Febrile patients (n, %)	6 168 (24.1)	229 (35.9)	271 (27.4)
Febrile patients receiving antipyretics (n, %)	4 338 (70.3)	174 (76.0)	216 (80.0)

Table 4. Vital signs, times and antipyretic usage in patients who were afebrile at triage but febrile determined by rectal temperature

Variables	Overall	Oral	Axillary	Temporal
Number of patients (*n*, %)	5 093 (18.8)	4 714 (17.4)	160 (0.6)	219 (0.8)
Initial temperature (°F)	98.9 (90.2–100.3)	98.9 (90.2–100.3)	98.5 (93.5–100.3)	98.5 (96–100.3)
Rectal temperature (°F)	101.3 (100.4–108)	101.3 (100.4–108)	101.5 (100.4–105.3)	101.5 (100.4–104.8)
Average difference (°F)	2.5 (0.1–14.3), $P<0.01$	2.4 (0.1–14.3), $P<0.01$	3.0 (0.2–9.2), $P<0.01$	3.0 (0.1–7.4), $P<0.01$
Pulse (beats per minute)	101.2 (35–208)	101 (35–208)	105 (44–160)	102.2 (42–175)
Respirations (breaths per minute)	19.6 (6–60)	19.6 (6–60)	26.3 (12–60)	20.3 (12–52)
Initial to rectal temperature time (minutes)	107.2 (0–2 159)	106. (0–2 159)	89.5 (12–1 464)	128.2 (12–1 641)
Initial temperature to antipyretic time (minutes)	139.3 (0–1 747)	138.5 (0–1 747)	119.2 (0–829)	165.8 (0–1 651)
Received antipyretics (*n*, %)	3 355 (65.9)	3 071 (65.1)	112 (70.0)	172 (78.5)

be admitted to the hospital, either to the floor (61.4%, $P<0.005$) or to the ICU or OR (8.1%, $P<0.005$). Of these patients, 636 (12.5%) received an antipyretic before their rectal temperature was documented.

DISCUSSION

In our study, we found a significant temperature difference between the initial triage and the subsequent rectal temperatures in the ED. This difference may actually be even higher given that one in the 13 patients received an antipyretic medication before their rectal temperature was performed. We also found that among the patients who were initially afebrile, those who were febrile detected by rectal measurement may also have had higher morbidity, as suggested by their higher admission rates to the hospital and critical care areas.

These findings are provocative for several reasons. First, it suggests that oral, axillary and temporal temperatures are unreliable for ruling out the presence of fever in adult ED patients. This study found that approximately one in five patients was initially afebrile in triage but was found to be febrile by rectal temperature. Second, these "temperature discordant" individuals were more likely to be admitted, suggesting that the presence of fever in our cohort is indicative of more severe disease. Furthermore, the admission rate of our entire sample was much higher than the average admission rate of 21% for our entire ED population. As such, to have received a rectal temperature, these patients were already in a more morbid cohort of patients.

We also found that measuring temperature by any non-invasive method was not as reliable as a rectal temperature for detecting fever. Numerous medical textbooks attempt to provide correlations between oral and rectal temperatures, but these have not been found to be clinically useful. Even in specific patient populations, studies frequently come to contradictory conclusions, including but not limited to healthy post-exercise athletes, adult inpatients, adult intensive care unit patients, and even pediatric patients, where temperature correlation studies are the most abundant.[10–21] Similarly, studies on axillary and temporal measurements show both great correlation and wide variation with the patient temperature.[22–25] Specific to our population, two prior studies showed poor agreement between oral, temporal and rectal temperatures in adult ED patients; one other study found good correlation between tympanic and rectal temperatures.[26–28] Importantly, none of these studies appeared to compare temperatures to initial triage temperatures, as in our study.

Some critics of rectal temperatures have proposed that the use of non-disposable, rectal thermometers may be contributing to an increase in rates of nosocomial *Clostridium difficile* (*C. difficile*) infections. There is limited evidence to support this concern.[29–30] Jernigan et al[31] demonstrated a decrease in C. difficile-associated diarrhea in patients who had temperatures taken with disposable versus reusable electronic thermometers, but did not find any significant difference in overall nosocomial infection rate or the rate of nosocomial diarrhea.

There are several limitations to our study. The first and foremost, its retrospective nature prevents a more in-depth analysis of the patients in the study. Second, while the study includes all patients receiving a rectal temperature in the study period, a rectal temperature is not a standard temperature assessment for all patients in our emergency department. It is commonly ordered on patients who are thought by physicians or nurses to be likely febrile, or in whom a fever would significantly change management. Some patients who are rectally febrile may have been missed. Though we found that 18.1% of the patients who were initially afebrile were later found to be febrile when assessed by a rectal temperature, there was no clear pattern to the pathology responsible for their fever. However,

the fact that over 60% of the patients in this cohort were admitted suggests that these patients represent a potentially high risk group. In addition, a rectal temperature is also rarely ordered on patients who present at triage with fever documented by non-rectal temperature assessment. As such, it is unclear if these rectal temperatures would have been significantly different from the triage temperature. The nature of our database does not allow us to find direct correlations between a patient's temperature and the pathology of the disease.

In conclusion, fever remains one of the most clinically important pieces of data when evaluating, diagnosing and determining patient management. In this retrospective cohort analysis, the largest ever conducted, we determined that there are significant differences between rectal temperatures and triage temperatures that were taken by oral, temporal or axillary routes. More importantly, we found that nearly one in five patients (18.8%) who were initially afebrile in triage was found to be febrile when their temperature was measured rectally. The implication is clear in any patient where the presence of fever would substantially alter their differential diagnosis or management, and obtaining a rectal temperature is essential.

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