

# An evaluation of tympanic thermometry in a paediatric emergency department

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**Background and objectives:** The consequences of missing fever in children can be grave. Body temperature is commonly recorded at the axilla but accuracy is a problem. This study aimed to evaluate the accuracy of a tympanic thermometer in the paediatric emergency setting.

**Method:** In a total of 106 infants, the body temperature was measured in the daytime with an infrared tympanic thermometer, and at the axilla with an electronic thermometer and at the rectum (gold standard for measurement of body temperature). Fever was defined as a rectal temperature of 38.0 °C or greater, axillary temperature of 37.5 °C or greater, and tympanic temperature of 37.6 °C or greater. The temperature readings at the three sites were compared statistically.

**Results:** There was a greater correlation of the tympanic measurement with the rectal measurement than the axillary with the rectal in both febrile and afebrile infants. The mean difference between the tympanic and rectal measurements was lower than that between the axillary and rectal measurements in both groups of infants (tympanic 0.38 °C and 0.42 °C, and axillary 1.11 °C and 1.58 °C, respectively). Tympanic measurements had a sensitivity of 76% whereas axillary measurements had a sensitivity of only 24% with rectal temperatures of 38–38.9 °C.

**Conclusion:** Tympanic thermometry is more accurate than measurement of temperature with an electronic axillary thermometer. It is also quick and safe, and thus it is recommended in the paediatric emergency setting.

Detection of fever in young children is important. A missed fever is serious, but a false positive fever reading can result in unnecessary investigation to rule out sepsis. Therefore measurement of body temperature should be as accurate as possible.

Body temperature is often recorded from the axilla using an electronic thermometer and, more recently, disposable strips such as TempaDot. The axilla is both easy to access and safe, but its accuracy remains a problem.<sup>1</sup> Rectal temperature is considered the gold standard for temperature measurement. This procedure is frightening for small children and may be harmful for older children. In addition, it is time consuming, often requiring a private room, removal of clothes, and a nurse in attendance, and it may lag behind a rapidly rising or falling core temperature.<sup>2</sup> The ideal means of measuring body temperature combines accuracy, speed, convenience, safety, and cost effectiveness.

The tympanic membrane is thought to reflect the true core temperature because of its proximity to the hypothalamus and a shared vascular supply.<sup>3</sup> Studies analysing the accuracy of tympanic temperature in neonates and infants, however, have produced conflicting results. Some studies have reported a high accuracy,<sup>4</sup> whereas others have not.<sup>5</sup>

We therefore carried out this study to determine the accuracy and the usefulness of a tympanic thermometer in a paediatric accident and emergency (A&E) of a district hospital.

## METHODS

The body temperature of 106 infants attending our A&E department was measured in the daytime using an infrared tympanic thermometer (Thermoscan Pro-3000; San Diego, CA) after obtaining informed, written consent. These measurements were compared with those obtained from the axilla with an electronic thermometer (IVAC, San Diego, CA), representing current practice at the A&E, and the rectum, representing the "gold standard" for measurement of body temperature.

The local research ethics committee approved the study.

Fever was defined as a rectal temperature of 38.0 °C or greater, axillary temperature of 37.5 °C or greater, and tympanic temperature of 37.6 °C or greater.<sup>6,7</sup> Paired Student's *t* test was used to compare the temperature measurements obtained by the different methods in febrile and afebrile infants.

## RESULTS

For all infants, the tympanic measurement correlated more closely with the rectal ( $r = 0.87$ ,  $p < 0.0005$ ) than the axillary measurement with the rectal ( $r = 0.69$ ,  $p < 0.0005$ ). In afebrile infants (rectal temperature  $< 38.0$  °C;  $n = 58$ ), tympanic measurement was closer to the rectal measurement (mean difference 0.38 °C, range 0.25–0.50 °C) compared with the axillary measurement to the rectal measurement (mean difference 1.11 °C, range 0.92–1.31 °C). Axillary measurement from three infants recorded temperatures of less than 35.0 °C, but these infants had a normal body temperature by rectal and tympanic measurements. In febrile infants also (defined as rectal temperature of 38.0 °C and greater;  $n = 48$ ), tympanic measurements correlated more closely with the rectal ( $r = 0.83$ ,  $p < 0.0005$ ) than the axillary measurements with the rectal ( $r = 0.67$ ,  $p < 0.0005$ ). The mean difference between the tympanic and rectal measurements was 0.42 °C (range 0.27–0.58 °C) and axillary to rectal measurements was 1.58 °C (range 1.37–1.80 °C).

The sensitivity of tympanic measurements to detect fever was 76% with rectal temperatures of 38–38.9 °C (the remaining 24% cases of "insensitivity" were measured in those with rectal temperature of 38.0–38.3 °C) and 100% with higher temperatures. The sensitivity of axillary measurement to detect fever was only 24% with rectal temperatures of 38.0–38.9 °C and 89% with higher temperatures. Tympanic thermometry was five times faster than measuring temperature with an electronic thermometer at the axilla. This could

lead to savings in time when nursing time for performing temperature measurement is considered.

## DISCUSSION

Our findings are consistent with other reports such as a review of 19 studies from 1989 to 1994 which concluded that tympanic measurements had moderate to strong correlation with oral, rectal and, core temperatures.<sup>8</sup> Tympanic thermometry has many potential benefits, particularly for a busy paediatric emergency setting. The technique is quick, safe, does not require the removal of clothing, easy to use without the risk of cross infection, and is not influenced by environmental temperature.

The sensitivity of tympanic measurements to detect fever was significantly higher than that of axillary measurements. The reason why tympanic thermometer could not achieve a higher sensitivity at rectal temperatures of 38.0–38.9 °C may be due to poor technique such as not targeting the eardrum, which emits the infrared energy, or to a small size of the external auditory canal in relation to the size of the scan probe. The latter reason may explain why some reports have shown lower accuracy of tympanic measurements in younger compared with older children.<sup>9</sup>

Fever being missed in a high percentage of children due to measurement at the axilla could have serious consequences regarding investigations and treatment.

## CONCLUSION

Tympanic thermometry is a practical method of measuring temperature in children in the emergency setting. It is more

accurate than the method of measurement with an electronic axillary thermometer, and it is recommended because of its potential benefits.

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