

## Comparison of Forehead Infrared Thermometry with Axillary Digital Thermometry in Neonates

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Fluctuations in core body temperature beyond a narrow range are of concern as they indicate changed homeostasis. Thermoregulation remains a key aspect of neonatal care. New 'non touch' method of measuring temperature may reduce infection rate and discomfort of neonates. Body temperature of neonates admitted in Neonatal Intensive Care Unit was measured using axillary digital thermometer and a handheld infrared non touch thermometer. The two methods did not agree well (mean difference = -0.5, 95% limits of agreement: [-2.3, 1.2]). The agreement was similar with a negligible difference when patients in open care warmers were excluded (mean difference = -0.6, 95% limits of agreement: [-2.3, 1.1]). As the accuracy is unsatisfactory, the said technology needs further improvement before it can be adapted for routine patient care.

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Accurate temperature recording remains an essential component of neonatal care. The best method to measure temperature should accurately reflect core body temperature and should not be affected by external factors. Axillary temperature measurement is recommended by American Academy of Pediatrics and National Association of Neonatal Nurses [1]. Mercury glass thermometer has been replaced by digital thermometer that is safer and more convenient.

Furthermore "minimal contact" being the guiding principle in neonatal care, more convenient methods have been developed to replace axillary thermometry [1].

The forehead is an excellent area to measure temperature as it is supplied by temporal artery, which receives high blood flow from the carotid artery. The concept of measuring forehead temperature with help of infrared thermometer seems promising as a simple, fast and convenient method, both for doctor/nurse and the patient [2].

We compared the temperature of neonates measured using Infrared forehead thermometer (IRFT) and digital axillary thermometer (DT). Unlike previous studies, many neonates in our study were managed in open care warmers. The study was approved by institutional Human Research Ethics Committee.

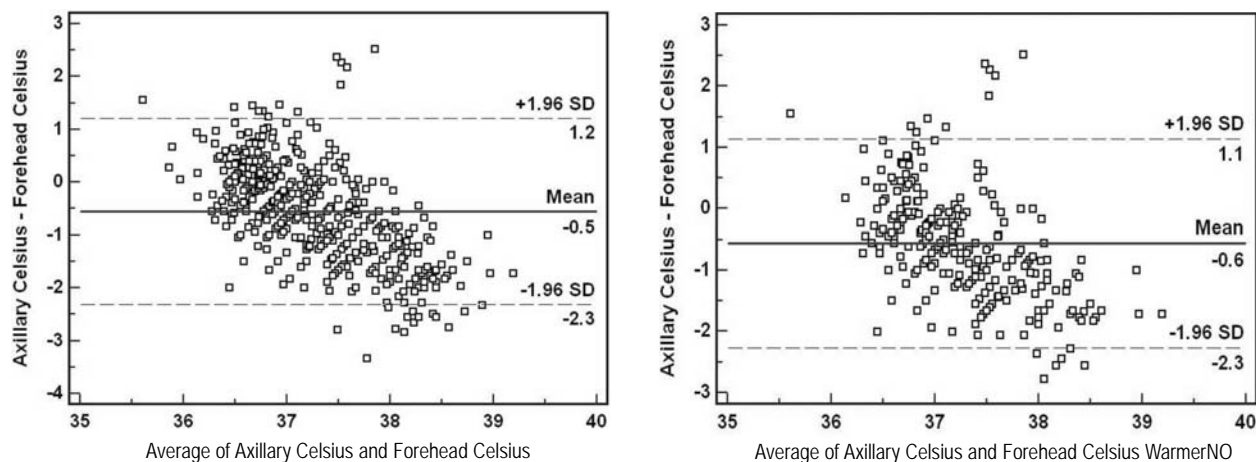
### METHODS

A prospective study was conducted to determine agreement between two methods of temperature assessment of newborns at Neonatal Intensive Care Unit (NICU) of the Shree Krishna Hospital, Gujarat, India. Neonates admitted in the NICU were enrolled in the study irrespective of their gestational age and diagnosis through convenience sampling. Quick Shot Infra-red Thermoscope (HT-F03B) was used to measure forehead temperature and Smart Care - Digital Thermometer (SCT01) was used to measure axillary temperature. Infrared forehead thermometry was held at 0.5 cm (approximately) from mid-forehead for recordings. Axillary temperature was taken after wiping underarm with dry towel and Digital thermometer probe tip was placed under the arm so the tip remained in contact with skin and the temperature reading was recorded after the beep sound from Digital thermometer. Structured training was imparted to nursing staff about the procedure and technique of using IRFT and DT.

Temperature readings were taken from newborns kept under radiant warmers as well as newborns kept on cot with their mothers. A skin probe was used with a set temperature of 36.5°C for neonates in NICU who were kept under open care servo-controlled radiant warmer. A room temperature of 25°C-30°C was maintained for neonates kept in intermediary care unit on cot. A single reading by each

## WHAT THIS STUDY ADDS?

- Infrared forehead thermometer provides unsatisfactory accuracy as compared to digital thermometer.



**FIG. 1** Bland–Altman plot showing comparison of body temperature measurements by axillary and no touch ( $^{\circ}\text{C}$ ) of all neonates, and (b) excluding neonates kept in warmer.

method was recorded 3 hourly in neonates for 7 days. A total of 520 readings were recorded in Celsius unit from 12 neonates. To study the degree of agreement between the two methods, standard methods suggested by Bland and Altman [3] were used and the mean difference with 95% confidence limits was reported for clinical consideration. A difference of  $0.5^{\circ}\text{C}$  was considered clinically acceptable.

## RESULTS

The body temperature measurements by axillary and forehead methods did not agree well (mean difference =  $-0.5^{\circ}\text{C}$ , 95% limits of agreement:  $[-2.3, 1.2]$ ) (**Fig. 1**). The agreement was similar with a negligible difference when patients in open care warmers were excluded (mean difference =  $-0.6^{\circ}\text{C}$ , 95% limits of agreement:  $[-2.3, 1.1]$ ) (**Fig. 2**).

## DISCUSSION

Infrared forehead thermometer was reported to be a simple, noninvasive instrument for measuring temperature accurately. Chiappini, *et al.* [2] reported a good agreement (mean difference =  $0.07^{\circ}\text{C}$ , 95% limits of agreement:  $[-0.62, 0.76]$ ) between Infrared forehead thermometry (IRFT) and axillary thermometry using glass mercury thermometer in pediatric population. In contrast, Fortuna, *et al.* compared IRFT to rectal thermometry in 200 children aged 1 month to 4 y with a mean age of 1.4 y and reported a broader 95% prediction band (on the order of  $4^{\circ}\text{F}$ ) which is clinically not useful. Moreover, the infrared measurements

overestimated rectal readings in hypothermia and underestimated rectal measurements in fever [4]. In the current study, we found a broader band for 95% limits of agreement and higher mean difference, Sener, *et al.* [5] reported similar result with slightly narrower band for 95% confidence limits (mean difference =  $0.2^{\circ}\text{C}$ , 95% limits of agreement:  $[-1.2, 1.6]$ ) in adult population [5]. Many factors may contribute to this discrepancy of findings from different studies. Previous studies have been conducted in different settings like NICUs, wards as well as in populations of different ages.

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