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Original Article

# Diagnostic Accuracy of Axillary and Forehead Thermometer Compared to Tympanic Thermometer among Children

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## Abstract

**Introduction:** Fever is a common manifestation of illness among children which results from infectious and non-infectious processes. Different types of measuring instruments are used at various sites to monitor body temperature. There are no methods that accurately approximate peripheral body temperature to core temperature. This study aimed to determine the diagnostic accuracy of axillary and forehead thermometers in comparison with tympanic thermometer among children (One to five years) and to compare the comfort during the three measurements.

**Methods:** This observational study included 728 consecutively selected children. Temperature was measured using forehead thermometer (index test), axillary thermometer (comparator) and tympanic thermometer (reference test). Sensitivity and specificity were calculated. COMFORT-B scale used to assess comfort during measurements. Reporting format- STARD-2015 was used.

**Results:** The sensitivity and specificity for axillary method were 93%, 94% and for forehead thermometer were 95%, 96% respectively. The Receiver Operator Characteristics- Area Under the Curve (ROC AUC) for axillary thermometer was 0.982 and for forehead thermometer 0.99. Median (IQR) scores were 14 (7) for axillary and 14 (6) for forehead and tympanic measurements. The median comfort scores were not statistically significant. ($P > 0.05$).

**Conclusions:** Both methods were good as screening methods for fever in children in the age group of one to five years. The forehead thermometer had a better diagnostic performance and accuracy and more comfortable than the axillary thermometer.

## Introduction

Infectious and non-infectious processes cause fever and its diagnosis is important for the treatment of children.[1] Core temperature is generally constant and accurate, needs invasive monitoring.[2] The rectal thermometry is considered as gold standard for fever measurement. But it is not in practice now.[3] Axillary measurements are preferable among children, but difficult for the caregiver for positioning and may result in inaccurate reading.[4] Tympanic thermometry is relatively new and popular.[5] It theoretically approximates to core temperature[6] and can be an acceptable option for paediatric temperature measurement.[7] It is reported that axillary temperature correlates well with tympanic temperature.[8] Forehead thermometer is contactless and not causing discomfort to child. It is recommended that both axillary and forehead thermometers are good screening tools that can be also used at home.[9]

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There is no consensus definition on fever.[2] The WHO defines fever as temperature above 37.5°C.[10] Based on the IMNCI standard treatment guidelines for fever in children two months to five years, fever is temperature above 37.5°C by axillary method.[11]

Parents reported axillary thermometer measurements were most uncomfortable for their children compared to tympanic and forehead thermometers and regarded forehead thermometers as most practical and convenient.[12] It was also reported that parents, children and nurses preferred tympanic thermometer than the axillary thermometer.[13] Contactless methods were preferred during the COVID-19 pandemic period. But it is not evident from literature that which one is more accurate in diagnosing fever.[14] There is a need for the assessment and comparison of different methods of body temperature among children to identify the most effective technique.[15] This study examined the diagnostic accuracy of axillary thermometer and forehead thermometer compared with tympanic thermometer among children (One to five years) and as a secondary objective, compared the comfort during measurements.

## Methods

This observational study compared the diagnostic accuracy of body temperature measurement using forehead thermometer (index test) and axillary thermometer (comparator) to tympanic thermometer (reference standard, approximates to core temperature due to closeness to thermoregulatory centre). The forehead and tympanic measurements were made using "DOCBEL (TH-300) Infrared thermometer (Dual mode)" and axillary thermometer was "Omron Digital Thermometer-model MC-246". Body temperature > 37.5°C for axillary temperature, > 37.8°C for tympanic temperature and > 37.5°C for forehead temperature were considered as fever. The study is reported based on STARD 2015 guidelines for reporting diagnostic accuracy studies. 728 children between one to five years admitted in the paediatric wards of a public sector tertiary care centre in Thiruvananthapuram, Kerala, India were enrolled. Children with aural pathology, clinical instability and non-cooperation were excluded. Sample size calculated was 552 for sensitivity 90, fever prevalence of 25% and absolute precision 5%. Data collection started after getting human ethics committee clearance. Informed consent obtained from parent / caretaker of all included children and provided participant information sheet. Axillary temperature measurement is the standard practice in the setting. For the study, all three measurements were made in degree Celsius (°C), with a precision of 0.1°C. Measurements were done on the second day of admission, in the morning between 8.00 am and 11.00 am to avoid time-related variability. There was an interval of five minutes between the measurements and measured while the child assumed a comfortable position. We used standard procedures for measurement depending on the type of thermometer. Aseptic practice and COVID-19 precautions ensured for all measurements. The children were randomized in to six groups using block randomization (WINPEPI statistical software, block size 12, 61 blocks) based on the order of the use of thermometers to avoid the potential bias from the ordering effects. There were two staff nurses who were trained on the method of data collection using the three thermometers. One person made the temperature measurements and another did the comfort assessment using the COMFORT- B scale at the time of assessment of body temperature to avoid inter-observer variations. A COMFORT-B score of ≥ 17 has been suggested as a threshold for discomfort.[16,17] The ambient room temperature recorded every day. The calibration of thermometers and battery change were done on a weekly basis. The data were collected using interview schedule, thermometers, and record review. A pilot study conducted in the same setting to assess the feasibility and practicability among 25 children and no modifications made. About 5-10 children were assessed per day and the study period extended from April 2022 to September 2022. The data entered in MS-Excel and analyzed using SPSS version 26 (SPSS Inc, Chicago, IL) and interpreted using descriptive and inferential statistics. Normality distribution of variables tested. Correct classification rate (a+d / a+b+c+d), sensitivity (a / a+c), specificity (d / b+d), predictive values (a / a+b and d / c+d), likelihood ratios [(a / a+c) / (b / b+d) and (c / a+c) / (d / b+d)] and diagnostic odds ratio [(a / a+c) / (b / b+d)] / [(c / a+c) / (d / b+d )] for axillary and forehead thermometers calculated for determining diagnostic accuracy compared to tympanic thermometer. Optimal cut-off was determined using ROC AUC. The study flow diagram is given in figure 1.

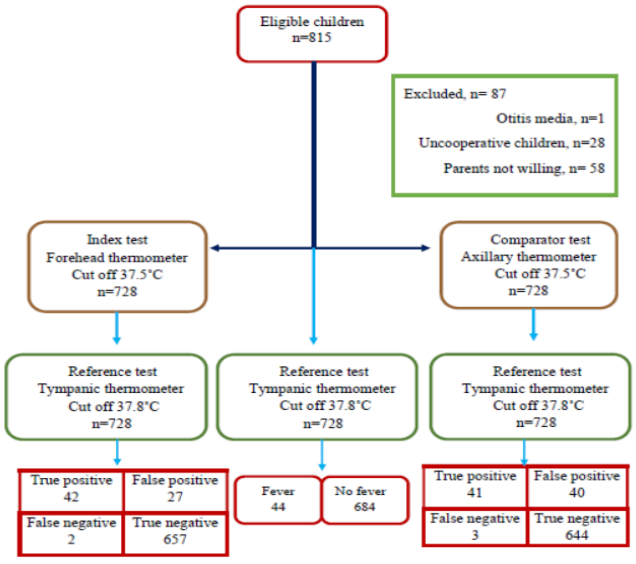



**Figure 1:** Study flow diagram

## Results

Majority of children (36.4%) belonged to one year and were boys (56.5%). Median (inter-quartile range, IQR) age was 2 (3) years. The median (IQR) body weight of the children was 12 (5.5) kg. The most common condition that sought hospital admission was respiratory diseases (63.7%). On admission, 43% of the children had fever as per the case record.

By forehead measurement 9.5 % had fever, median (IQR) 36.67°C (36.2°C to 37.0° C). On axillary measurement, 11.1% of the children had fever, median (IQR) 36.78°C (36.33°C to 37.11°C). On tympanic measurement 6% had fever and median (IQR) 36.67°C (36.22°C to 36.94°C). Median axillary temperature was 0.1°C higher. Most of the children (52%) assumed supine position for all measurements. Majority of the children (97.4%) did not have bath with in last 6 hours and 41% had antipyretic medication during last 24 hours. Comparison of body temperature measurement by the three thermometers are given in table no. 1.

**Table 1:** Body temperature measurement using axillary, forehead and tympanic thermometers

| Axilla | Tympanic | | Total | Forehead | Tympanic | | Total |
|---|---|---|---|---|---|---|---|
| | Fever | No fever | | | Fever | No fever | |
| Fever | 41 | 40 | 81 | Fever | 42 | 27 | 69 |
| No fever | 3 | 644 | 647 | No fever | 2 | 657 | 659 |
| Total | 44 | 684 | 728 | Total | 44 | 684 | 728 |

**Table 2:** Test properties of axillary thermometer and forehead thermometer compared to tympanic thermometer

| Test property | Axillary thermometer | Forehead thermometer |
|---|---|---|
| | Value (95% confidence interval) | Value (95% confidence interval) |
| Sensitivity | 93% (81% to 99%) | 95% (85% to 99%) |
| Specificity | 94% (92% to 96%) | 96% (94% to 97%) |
| Positive predictive value (PPV) | 51% (39% to 62%) | 61% (48% to 72%) |
| Negative predictive value (NPV) | 99.99% (99.7% to 100.00%) | 99.99% (0.998 to 100.00) |
| Positive Likelihood Ratio (LR+) | 15.93 (11.67 to 21.75) | 24.18 (16.62 to 39.19) |
| Negative Likelihood Ratio (LR-) | 0.07 (0.02 to 0.22) | 0.05 (0.01 to 0.18) |
| Diagnostic odds ratio (DOR) | 220.03 (65.29 to 741.56) | 511 (117.52 to 2222.02) |

The diagnostic properties calculated based on the above table is given in the following table (Table no. 2). The ROC AUC was 0.99 (95% CI 0.98-0.99) for forehead thermometer and the best cut-off for detecting fever was 37.5° C where the sensitivity was 98% and false positivity rate of 4.5% with the Youden index of 93 (95% CI 85 to 98). The ROC AUC was 0.98 (95% CI 0.97 to 0.99) for axillary thermometer. The best cut-off for detecting fever was 37.4° C where the sensitivity was 98% and false positivity rate of 8% and the Youden index was 90 (95% CI; 80 to 95). (Figure 2).

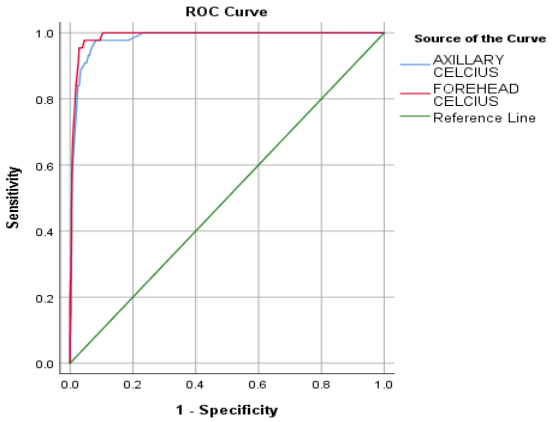



**Figure 2:** ROC curve for axillary thermometer and forehead thermometer

Ref. std. Tympanic thermometer

Comparator test Axillary thermometer: AUC (95% CI) 0.982 (0.970 to 0.993) ***, P <0.001

Index test Forehead thermometer: AUC (95% CI) 0.990 (0.983 to 0.996) ***, P <0.001

**Table 3:** Comparison of median comfort scores of body temperature measurement by axillary, forehead and tympanic thermometers

| Method | N | Median comfort score | IQR | Mean rank | Test statistic | Df | P value |
|---|---|---|---|---|---|---|---|
| Axillary | 728 | 14 | 11 to18 | 2.06 | 72.64*** | 2 | < 0.001 |
| Forehead | 728 | 14 | 11 to 17 | 2.01 | | | |
| Tympanic | 728 | 14 | 11 to 17 | 1.93 | | | |

***P < 0.001

**Table 4:** Pair-wise comparison of median comfort scores of body temperature measurement by axillary, forehead and tympanic thermometers

| Pair | Test Statistic | Std. Error | Std. Test Statistic | p value | Adj. p value |
|---|---|---|---|---|---|
| Tympanic -Forehead | 0.074 | 0.052 | 1.415 | 0.157 | 0.471 |
| Tympanic -Axillary | 0.124 | 0.052 | 2.359* | 0.018 | 0.055 |
| Forehead – Axillary | 0.049 | 0.052 | 0.943 | 0.345 | 1.000 |

* P value < 0.05

Most of the children (70.3 to 72.7 %) reported comfort with median (IQR) scores 14 (6) for forehead and tympanic and 14 (7) for axillary measurements. The Friedman's ANOVA for ranks showed that the difference in median comforts scores by the three methods statistically significant (P < 0.001) (Table no. 3).

Wilcoxon sign rank test with Bonferroni correction showed that there was no significant difference (adjusted P value > 0.05) between the pairs (Table no. 4).

## Discussion

This study results showed that forehead thermometer has a sensitivity of 95% (95% CI 85% to 99%) at a threshold of 37.5$^0$C compared to the tympanic thermometer with a threshold of 37.8°C. The reported specificity was 96% (95% CI 94% to 97%). The PPV indicates that a child who has been diagnosed as having fever by forehead thermometer has a 61% probability to have fever and the NPV as 99.9%. A systematic review and metanalysis on diagnostic accuracy of non-contact infrared thermometers and thermal scanners has reported a pooled sensitivity of forehead infrared thermometers as 81% (95% CI 65% to 90%).[18] Another study reported the sensitivity as 0.81, specificity as 0.98, PPV as 0.90 and NPV as 0.96.[19] In our study, axillary thermometers can correctly identify 93% of the children who have fever when the fever threshold is 37.5°C compared to tympanic thermometer the threshold of 37.8°C. A study has reported the sensitivity of axillary thermometer as 91.7% (95% CI 80.0 to 97.7%) at a fever threshold of 37°C.[20] Another study had reported a sensitivity of 88%.[21] The PPV indicates that a child who has been diagnosed as having fever by axillary thermometer has the probability of 51% to have fever, which is not a good at thermometer estimate compared to the forehead in this study. When the sensitivity and specificity are very high, the false negative and false positive rates will be very low. In this study the false negative rates are less than the false positive rates. This is explained by the low prevalent state of fever at the time of measurement in sample studied. It may also be due to the problem with accuracy of the sensor or algorithm of the thermometer which is used to compensate for the low forehead readings compared to the reference sites.[22] So, it will serve more as a screening tool. When the prevalence is low, forehead thermometer is better than axillary thermometer, when the prevalence is high, both the thermometers perform almost equally. In this study, diagnostic odds ratio of forehead thermometer is 511 and axillary thermometer is 220. It is a single indicator of a test's performance. The higher the value, the better the test performance. It can range between zero and infinity, which is similar to an odds ratio, odds of positivity in the abnormal reference group compared to the odds of positivity in the normal reference group.[23]

The ROC AUC was 0.99 (95% CI; 0.98 to 0.99, P<0.001) for forehead thermometer in this study and the best cut-off for detecting fever was 37.5°C based on the coordinates, which is same as the study cut-off. As per another study, the ROC-AUC (gold standard rectal temperature) of forehead temperature was 0.906 (95% CI 0.87- 0.94).[24] In this study, the ROC-AUC was 0.98 (95% CI 0.97 to 0.99) for axillary thermometer and the best cut-off for detecting fever was 37.4° C. The new cut-off reported 98% sensitivity and 92% specificity where there is a gain of 5% sensitivity at the cost of 2% loss of specificity. When the new cut-off is applied to the study data, the proportion of fever by axillary method increased to 14.8 from 11.1 by increasing the false positives.

There was no appreciable change in sensitivity and specificity when the new cut-off was applied in the study data as the new cut off is very close to the study cut off 37.5°C. Considering the consistent presence of sweat in the axilla and its distance from the thermoregulatory centre, usually 0.5°C to1.0°C are added to axillary temperature.[25] A study reported ROC AUC 98.3 for axillary thermometer at a temperature of > 38°C compared to oral thermometer.[26]

Most of the children (70.3 to 72.7 %) reported tympanic measurements as most comfortable with a mean rank of 1.93 compared to forehead and axillary measurements with mean ranks 2.01 and 2.06 respectively, though there was no statistical significance in post-hoc analysis. A study reported that children preferred tympanic thermometer over axillary thermometer.[13] In a study, that compared forehead, axillary and tympanic thermometers, parental satisfaction and child comfort were highest for the forehead thermometers.[28] Though forehead thermometer is non-intrusive, its positioning in front of face may be a threatening experience for small children which might have resulted in a comfort score less than that of tympanic thermometer. The forehead thermometer carries the advantage of non-contact method which is advantageous in situations like COVID-19.

Major strengths of the study were larger sample size, temperature measurement by same observer and during the morning time helped in reducing inter-observer and time related variability, small interval of five minutes between measurements and weekly calibration and battery change of thermometers ensured avoidance of measurement error, and inclusion of all children admitted and measurement on the second day of admission prevented the spectrum bias. The study had some limitations like tympanic thermometer may not be the best reference standard, same cut off for fever was taken for all children irrespective of age, measurement error due to inaccuracy of sensors or algorithm of tympanic and forehead thermometers cannot be excluded, and the selected thermometers may not be representative of all thermometers available in the market.

## Conclusions

This study found that the axillary thermometer and forehead thermometer have very good diagnostic properties in terms of sensitivity and NPV. The forehead thermometer has a better diagnostic accuracy compared to axillary thermometer and they are good as screening methods for fever in children. The new cut off identified by ROC analysis was 37.4°C for axillary thermometer, very close to the cut off used in the study to diagnose fever. The new cut off identified by ROC analysis for forehead thermometer was 37.5°C, the same cut off originally used in diagnosing fever. Thus, the new cut off for axillary thermometer did not show significant improvement in Sensitivity and Specificity. There is no significant difference between the median comfort score for the three measurements and axillary measurement is reported to be the least comfortable.

**Conflict of Interest**: None

**Funding Source:** None

## References

1. El-Radhi AS. Fever in Common Infectious Diseases. Clinical Manual of Fever in Children. 2019;85-140
DOI: 10.1007/978-3-319-92336-9_5
2. Hymczak H, Gołb A, Mendrala K, Plicner D, Darocha T, Podsiadło P, et al. Core Temperature Measurement-Principles of Correct Measurement, Problems, and Complications. Int J Environ Res Public Health. 2021 Oct 10;18(20):10606
DOI: 10.3390/ijerph182010606
PMID: 34682351; PMCID: PMC8535559
3. Paramita T, Karyanti MR, Soedjatmiko S, Hendarto A, Suyoko D, Latief A. A comparison of axillary and tympanic membrane to rectal temperatures in children. Paediatr Indones. 2017 Feb;57(1):47-51
DOI: 10.14238/pi57.1.2017.47-51
4. Zhen C, Xia Z, Ya Jun Z, Long L, Jian S, Gui Ju C, et al. Accuracy of infrared tympanic thermometry used in the diagnosis of Fever in children: a systematic review and meta-analysis. Clin Pediatr (Phila). 2015 Feb;54(2):114-26
DOI: 10.1177/0009922814545492
PMID: 25104731
5. Castro Alonso P, Machin G. Body temperature measurement uncertainty arising from ear canal geometry and temperature gradients. Measurement: Sensors. 2022;24: 100417
DOI: 10.1016/j.measen.2022.100417
6. Ring EF, McEvoy H, Jung A, Zuber J, Machin G. New standards for devices used for the measurement of human body temperature. J Med Eng Technol. 2010 May;34(4):249-53
DOI: 10.3109/03091901003663836
PMID: 20397848
7. Marui S, Misawa A, Tanaka Y, Nagashima K. Assessment of axillary temperature for the evaluation of normal body temperature of healthy young adults at rest in a thermoneutral environment. J Physiol Anthropol. 2017 Feb 22;36(1):18.
DOI: 10.1186/s40101-017-0133-y
PMID: 28228153; PMCID: PMC5322586
8. Jagatha ML, Tamilarasan P, Krishnamurthy K. Measuring temperature in children, conveniently and accurately: a comparative study on different modalities of thermometry. Int J Contemp Pediatr. 2021;8(11):1804
DOI: 10.18203/2349-3291.ijcp20214149
9. Sang BH, Lee C, Lee DY. Prospective comparative analysis of noninvasive body temperature monitoring using zero heat flux technology (SpotOn sensor) compared with esophageal temperature monitoring during pediatric surgery. PLoS One.

2022 Aug 8;17(8):e0272720
DOI: 10.1371/journal.pone.0272720
PMID: 35939499; PMCID: PMC9359523

10. Niven DJ, Gaudet JE, Laupland KB, Mrklas KJ, Roberts DJ, Stelfox HT. Accuracy of peripheral thermometers for estimating temperature: a systematic review and meta-analysis. Ann Intern Med. 2015 Nov 17;163(10):768-77
DOI: 10.7326/ M15-1150.
PMID: 26571241

11. Hayward G, Verbakel JY, Ismail FA, Edwards G, Wang K, Fleming S, et al. Non-contact infrared versus axillary and tympanic thermometers in children attending primary care: a mixed-methods study of accuracy and acceptability. Br J Gen Pract. 2020 Mar 26;70(693):e236-e244
DOI: 10.3399/bjgp20X708845. Erratum in: Br J Gen Pract. 2020 Oct 1;70(699):486.
DOI: 10.3399/bjgp20X712769
PMID: 32205332; PMCID: PMC7098492

12. Barton SJ, Gaffney R, Chase T, Rayens MK, Piyabanditkul L. Pediatric temperature measurement and child/parent/nurse preference using three temperature measurement instruments. J Pediatr Nurs. 2003 Oct;18(5):314-20
DOI: 10.1016/s0882-5963(03)00103-9
PMID: 14569579

13. Erdem N, Demirdağ TB, Tezer H, Cura-Yayla BC, Baran-Aksakal FN, Tapısız A, et al. The comparison and diagnostic accuracy of different types of thermometers. Turk J Pediatr. 2021;63(3):434-442
DOI: 10.24953/turkjped.2021.03.010
PMID: 34254488

14. Barbi E, Marzuillo P, Neri E, Naviglio S, Krauss BS. Fever in Children: Pearls and Pitfalls. Children (Basel). 2017 Sep 1;4(9):81
DOI: 10.3390/children4090081
PMID: 28862659; PMCID: PMC5615271

15. Hughes D, Breatnach C, van Dijk M, Magner C, Paul C. Assessing The Validity And Reliability Of The Comfort-behaviour Scale In Children Three Years Of Age And Over. Arch Dis Child. 2014;99:A534-A535
DOI:10.1136/archdischild-2014-307384.1491

16. Saelim K, Chavananon S, Ruangnapa K, Prasertsan P, Anuntaseree W. Effectiveness of Protocolized Sedation Utilizing the COMFORT-B Scale in Mechanically Ventilated Children in a Pediatric Intensive Care Unit. J Pediatr Intensive Care. 2019 Sep;8(3):156-163
DOI: 10.1055/s-0039-1678730
PMID: 31402992; PMCID: PMC6687447

17. Aggarwal N, Garg M, Dwarakanathan V, Gautam N, Kumar SS, Jadon RS, et al. Diagnostic accuracy of non-contact infrared thermometers and thermal scanners: a systematic review and meta-analysis. J Travel Med. 2020 Dec 23;27(8):taaa193
DOI: 10.1093/jtm/taaa193
PMID: 33043363; PMCID: PMC7665626

18. Kim YM, Jang MR, Moon JR, Park G, An YJ, Seo JM. Clinical Accuracy of Non-Contact Forehead Infrared Thermometer Measurement in Children: An Observational Study. Children (Basel). 2022 Sep 14;9(9):1389
DOI: 10.3390/children9091389
PMID: 36138700; PMCID: PMC9497495

19. Teller J, Bernasconi R, Simonetti GD, Lava SAG. Performance of axillary and rectal temperature measurement in private pediatric practice. Eur J Pediatr. 2019 Oct;178(10):1501-1505
DOI: 10.1007/s00431-019-03438-0
PMID: 31396691

20. Padilla-Raygoza N, Diaz-Guerrero R, Garcia-Valenzuela P, Pantoja-Hernandez M. Comparison of measurements of body temperature with four thermometers in a children health care setting. Comparison of thermometers. Internet J Pediatr Neonatol. 2010;13(2)
DOI:10.5580/191b

21. Lye PS, Densmore EM. Fever. Nelson Pediatric Symptom-Based Diagnosis. 2018:701–725.e2
DOI: 10.1016/B978-0-323-39956-2.00039-X
PMCID: PMC7173579

22. SAR, Williams GM, editors. Methods of Clinical Epidemiology [Internet]. Berlin, Heidelberg: Springer Berlin Heidelberg; 2013 [cited 2022 Nov 28]. (Springer Series on Epidemiology and Public Health).
DOI: 10.1007/978-3-642-37131-8

23. Chatproedprai S, Heamawatanachai K, Tempark T, Wananukul S. A Comparative Study of 3 Different Methods of Temperature Measurement in Children. J Med Assoc Thai. 2016 Feb;99(2):142-9
PMID: 27249893

24. Del Bene VE. Temperature. In: Walker HK, Hall WD, Hurst JW, editors. Clinical Methods: The History, Physical, and Laboratory Examinations. 3rd edition. Boston: Butterworths; 1990. Chapter 218

25. Kanegaye JT, Jones JM, Burns JC, Jain S, Sun X, Jimenez-Fernandez S, et al. Axillary, Oral and Rectal Routes of Temperature Measurement During Treatment of Acute Kawasaki Disease. Pediatr Infect Dis J. 2016 Jan;35(1):50-3
DOI: 10.1097/INF.0000000000000923
PMID: 26398742; PMCID: PMC4706471

26. Van den Bruel A, Verbakel J, Wang K, Fleming S, Holtman G, Glogowska M, et al. Non-contact infrared thermometers compared with current approaches in primary care for children aged 5 years and under: a method comparison study. Health Technol Assess. 2020 Oct;24(53):1-28

DOI: 10.3310/hta24530
PMID: 33111663; PMCID: PMC7681337