Evaluation of axillary and tympanic thermometry to detect fever and hypothermia in young infants: A repeatability and accuracy study

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Background

- Body temperature is a vital sign commonly used for disease diagnosis, treatment and prognosis

- Fever or hypothermia may be the only sign of severe infections in SICK young infants (aged 0-59 days)

- Improved temperature measurement is paramount for improving diagnosis and treatment of severe infections in young infants and could contribute to increasing their survival

- Repeatability and accuracy data among young infants is lacking for commonly used methods like axillary and tympanic thermometry

Objectives

❑ Overall objective

To assess the repeatability and accuracy of axillary and tympanic thermometry in identifying hypothermia and fever in young infants

❑ Specific objectives

▪ Estimate repeatability of rectal, tympanic, and axillary measurements

▪ Estimate the accuracy of axillary/tympanic measurements for identifying Hypothermia/Fever using rectal measurements as the gold standard

Methods

❑Site

- Mulago national referral Hospital, Uganda
  - o Acute Care Unit and General pediatric wards
  - o Postnatal ward

❑ Study participants

- 713 young infants
  - o 482 neonates ; 0-27 days
  - o 231 older young infants aged 28 - 59 days

❑ Temperature measurements

- Two temperature measurements taken for each thermometry method

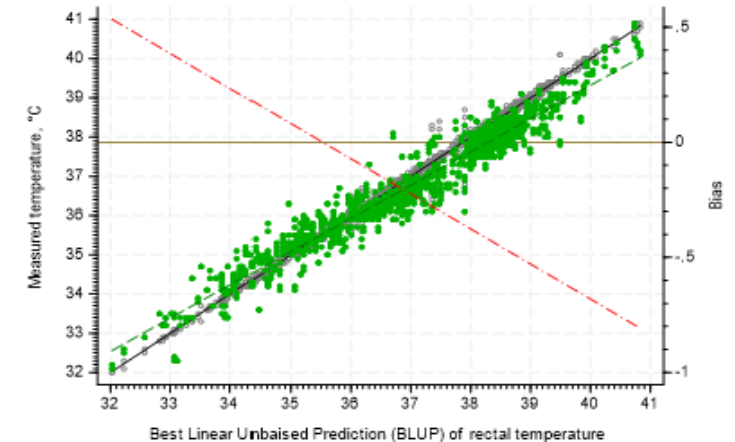# Agreement between axillary or tympanic vs. rectal thermometry: Biasplot analysis*

❑ Repeatability

- All three methods showed excellent repeatability (%CV ≤ 0.5%):

❑ Agreement

Axillary thermometry:

o Overestimates rectal temperatures (RT) when <35.6°C

o Underestimates RT when RT ≥35.6°C

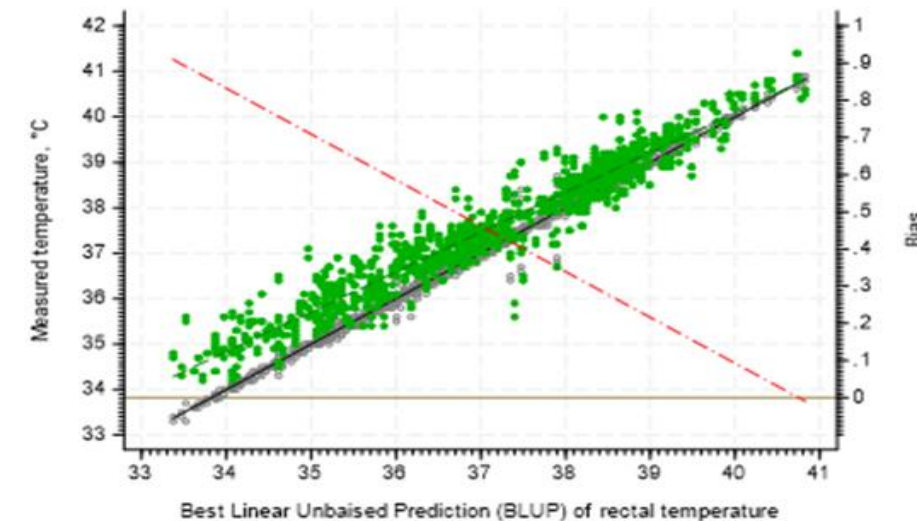o Bias ranges from +0.55°C at RT 32.0°C to -0.8°C at RT 41.0°C

*Taffé P. Assessing bias, precision, and agreement in method comparison studies. Stat Methods Med Res 2020;29:778-96

Agreement between tympanic with rectal thermometry: Biasplot analysis*

❑Tympanic thermometry:

- Overestimates RT
- Bias ranges from +1.3°C at RT 32.0°C to 0.0°C at RT 40.8°C

*Taffé P. Assessing bias, precision, and agreement in method comparison studies. Stat Methods Med Res 2020;29:778-96

Accuracy of axillary or tympanic using rectal thermometry as a gold standard

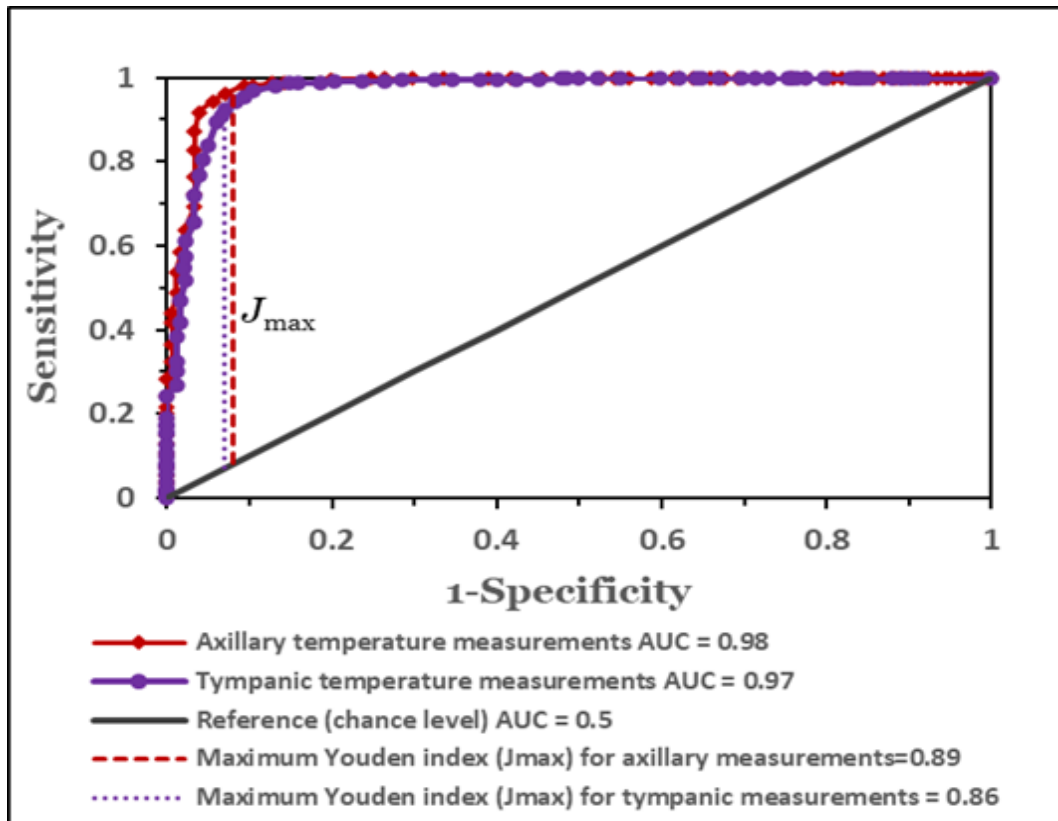Based on WHO's temperature cutoff from 2014:

- Rectal temperature of <36.0°C defines hypothermia, of ≥38.0°C defines fever

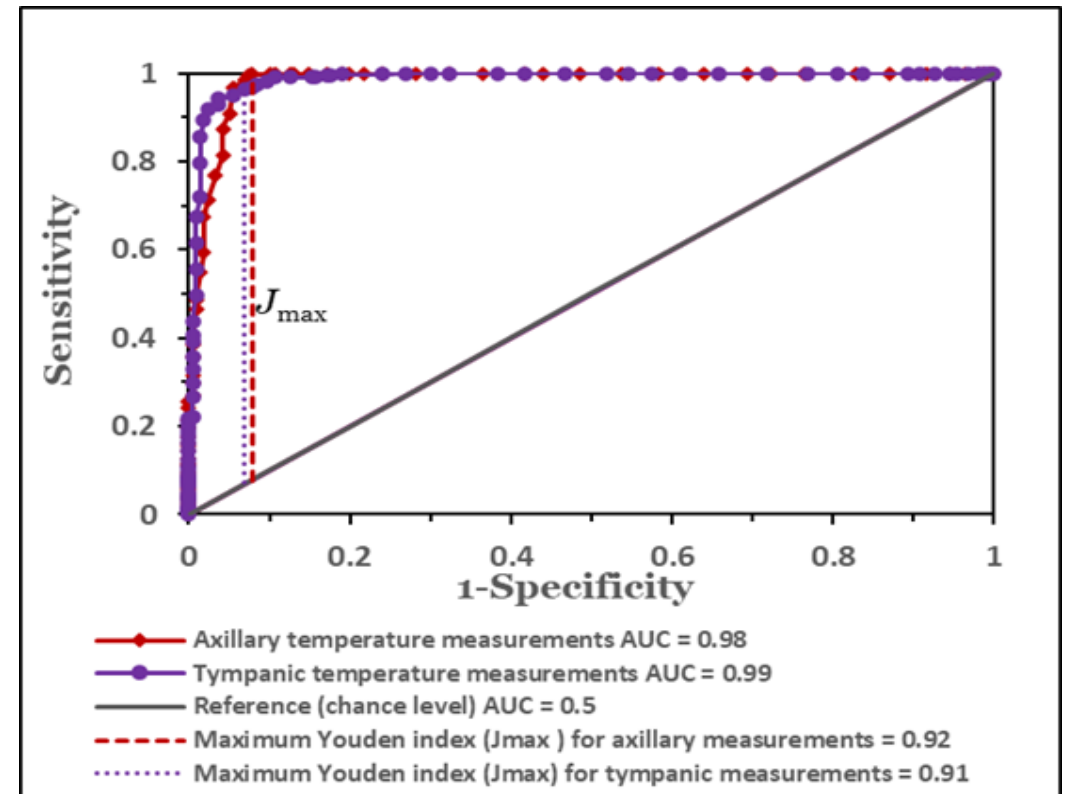| Method	Hypothermia			Fever		
	Temp	Sensitivity	Specificity	Temp	Sensitivity	Specificity
Axillary	<35.5°C	70%	100%	≥37.5°C	98%	93%
Tympanic	<35.8°C	58%	100%	≥37.8°C	99%	85%

Diagnostic accuracy

❑ ROC curves and estimated Area Under the Curve (AUC)

Hypothermia

Fever

Optimal threshold temperature limits

❑ Based on the cutoff-temperatures which give the largest possible Youden's J statistic   i.e. maximizes the sum of sensitivity and specificity)

Method	Hypothermia			Fever		
	Temp	Sensitivity	Specificity	Temp	Sensitivity	Specificity
Axillary	<36.0°C	94%	95%	≥37.5°C	98%	93%
Tympanic	<36.5°C	97%	90%	≥38.0°C	98%	95%

Clinical implications and cutoff recommendations

❑ 2014 –WHO-IMCI cutoffs show high specificity but lower sensitivity for detecting hypothermia using axillary thermometry.

❑ Axillary and tympanic thermometry effectively detect hypothermia and fever in young infants, but defining precise cutoff temperatures is crucial for improving diagnostic accuracy.

❑ Recommended cutoffs (for sensitivity and specificity):
- **Hypothermia:**
  - <36.0°C (Axillary)
  - <36.5°C (Tympanic)
- **Fever:**
  - ≥37.5°C (Axillary)
  - ≥38.0°C (Tympanic)

Conclusion

Axillary thermometry ("optimized") has a high sensitivity and specificity for detecting fever as well as hypothermia among young infants

Acknowledgements:

Babies who participated

She's grown....

Thank you for listening