

Non-contact infrared thermometers for measuring temperature in children:

primary care diagnostic technology update

Clinical Question

What is the accuracy and utility of non-contact infrared thermometers compared to conventional thermometers in children?

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BACKGROUND AND ADVANTAGES OVER EXISTING TECHNOLOGY

Temperature is an important vital sign for assessing acutely unwell children, and is measured frequently in primary care. However, measuring temperature accurately can be challenging. Oral and rectal thermometers are invasive and poorly tolerated, while axillary thermometers require parents or healthcare professionals to undress the child and hold the thermometer in the axilla for 30 seconds or longer. Infrared tympanic thermometers are easier to use, but can be inaccurate due to ear wax or insufficient straightening of the ear canal. Non-contact infrared thermometers (NCITs) are designed to measure temperature rapidly and non-invasively with negligible cross-infection risk. This update compares the accuracy and utility of NCITs with conventional thermometers in children.

DETAILS OF TECHNOLOGY

Table 1 summarises characteristics of a range of NCITs. Based on a search conducted in December 2013, over 20 models are available for use in community and/or healthcare settings. The Thermofocus and Syner-Med VeraTemp thermometers are FDA approved and CE marked. This report found six studies comparing three NCIT devices (Standard ST 8812¹, Thermofocus 0800^{2,3} and Thermofocus 01500⁴⁻⁶) to conventional thermometers in children.

PATIENT GROUP AND USE

NCITs may be used to measure temperature in children presenting with acute illness in primary or emergency care settings, or while being monitored at home during an illness episode.

PREVIOUS RESEARCH

Accuracy compared to existing technology

One study compared the Standard ST 8812 with infrared tympanic thermometry.¹

Based on 1000 pairs of readings from 567 hospitalised children, the mean difference was $\pm 2.34^{\circ}\text{C}$. A Standard ST 8812 temperature cut-off point of 35.1°C detected fever (tympanic temperature $>38^{\circ}\text{C}$) with a sensitivity of 89% and specificity of 75%.

One study compared the Thermofocus 0800 with mercury in-glass axillary thermometry ($n = 251$).² The Thermofocus 0800 detected fever with a sensitivity of 89% and specificity of 90%. Readings were strongly correlated with axillary temperatures ($r^2 = 0.837$, $P < 0.001$). In another study, the Thermofocus 0800 detected fever with a sensitivity of 77% and specificity of 79% compared to an electronic thermometer.³ A moderate correlation between temperature readings was observed ($r = 0.66$, $P < 0.001$).

Two studies compared the Thermofocus 01500 with mercury in-glass⁴ or electronic⁵ rectal thermometers. One reported a strong correlation with rectal temperatures ($r = 0.952$, $P < 0.001$).⁴ This study recruited 434 children from emergency room or inpatient settings and recorded three consecutive temperature readings with each thermometer. A Thermofocus 01500 temperature reading of $\geq 38^{\circ}\text{C}$ detected fever (rectal temperature of $\geq 38^{\circ}\text{C}$) with sensitivity and specificity of 97%. A smaller study, which recruited 200 children from a tertiary paediatric emergency department, reported only moderate agreement with rectal temperature ($r^2 = 0.48$, $P < 0.01$), but did not obtain multiple temperature readings.⁵ This study also found that the Thermofocus 01500 overestimated rectal temperature in patients with lower temperatures and underestimated temperature in patients with higher temperatures ($r^2 = 0.149$, $P < 0.01$).

One study including 90 children (inpatients and outpatients), reported a weak correlation between temperatures measured using the Thermofocus 01500 and three different reference standards (tympanic, temporal artery and axillary thermometry; $r^2 = 0.029$, $P < 0.0001$).⁶

Table 1. Characteristics of non-contact infrared thermometers

Name of thermometer	Company	Method of use	RRP
Kinetik Model NCT1	Kinetik Medical Devices Ltd, UK	Held 1–3 cm from forehead	19.99 GBP
Syner-Med VeraTemp	American Scientific Resources Inc, Washington, US	Held 5–8 cm from forehead	44.99 GBP
Extech IR200	Extech Instruments Corporation, Nashua, US	Held 5–15 cm from forehead	68.92 GBP
Thermofocus 01500	Technimed Inc, Italy	Held 3 cm from forehead, neck, umbilicus or axilla	89.99 GBP
Thermofocus 0800 ^a	Technimed Inc, Italy	Information available on request	126.99 GBP
Professional Clinical RY210	Santa Medical, Tustin, US	Held 5–15 cm from forehead	128.95 USD
Standard ST 8812	Standard Instruments Co, Ltd, Hong Kong SAR, China	Held 5 cm from forehead	Available on request

^aCurrent model is Thermofocus 0800H5. For hospital or clinic use only. RRP = recommended retail price.

Impact compared to existing technology

In a small number of studies NCITs were reliable at ruling out fever (negative predictive value 91–98%) but proved more reliable at ruling in fever when compared to mercury in-glass^{2,4} as opposed to electronic thermometer^{1,3} fever thresholds. Performance may be improved by taking an average of repeated measurements, allowing sufficient time for children's temperature to stabilise and taking temperature when children are not emotionally distressed.^{2–4} NCITs may be of particular value to parents, carers and healthcare professionals when measuring temperature in children while they are sleeping and in children who cannot tolerate other thermometers. In three studies, Thermofocus thermometers caused significantly less distress to children than mercury in-glass^{2,4} or electronic³ thermometers.

Cost effectiveness and economic impact

Currently no literature exists on the cost effectiveness or economic impact of using NCITs to measure temperature in children. Although some models of NCIT are considerably more expensive than conventional thermometers, NCIT use may bring long-term cost savings in terms of reduced staff time (quicker to obtain readings) and material costs (no disposable probe covers needed). Time required to obtain temperature readings has already been established as an important driver of total costs associated with using different types of thermometer.⁷

Relevant guidelines

The 2013 NICE guideline on feverish illness in children <5 years⁷ recommends that temperature should be measured using an electronic or chemical dot axillary thermometer or an infrared tympanic thermometer in children aged 4 weeks to 5 years. An electronic axillary thermometer should be used in infants <4 weeks old. The Canadian Paediatric Society⁸ recommends that definitive temperature should be measured using an electronic rectal thermometer and screening temperature using an electronic axillary thermometer in children aged ≤5 years. Tympanic thermometers may be used for screening temperatures in children aged >2 years. Neither guideline makes any recommendations about NCIT use.

What this technology adds

Early evidence suggests that NCITs may provide a rapid, hygienic, and non-invasive means of ruling out fever in children. Published data have so far demonstrated that NCITs have high sensitivity and specificity in detecting fever. However, these findings are mostly based on small studies conducted in hospital inpatient and emergency department settings. Further research is therefore needed to determine the accuracy and utility of NCITs in primary care. In particular, optimal fever thresholds need to be established in community versus hospital settings and procedures for obtaining reliable measurements need to be evaluated, taking into consideration the value of obtaining multiple readings and additional factors such as sweating, clothing, and changes in ambient temperature; for example due to external heaters, such as radiators. The cost effectiveness of using NCITs to screen for fever and measure temperature in children also needs to be determined.

Methodology

Standardised methodology was applied in writing this report, using prioritisation criteria and a comprehensive, standardised search strategy, and critical appraisal. (Further details of the methodology of Horizon scan reports are available from www.madox.org/horizon-scanning-report.)

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Competing interests

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