Evaluation of Non-invasive Thermometers in Endoscopy Setting

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Purpose

The primary purpose of the study was to determine the level of agreement between a clinical reference thermometer (non-disposable oral electronic) and three non-invasive test thermometers:

Figure 1 Temporal artery thermometer

Figure 2 Non-contact infrared thermometer

Figure 3 Disposable oral electronic digital thermometer

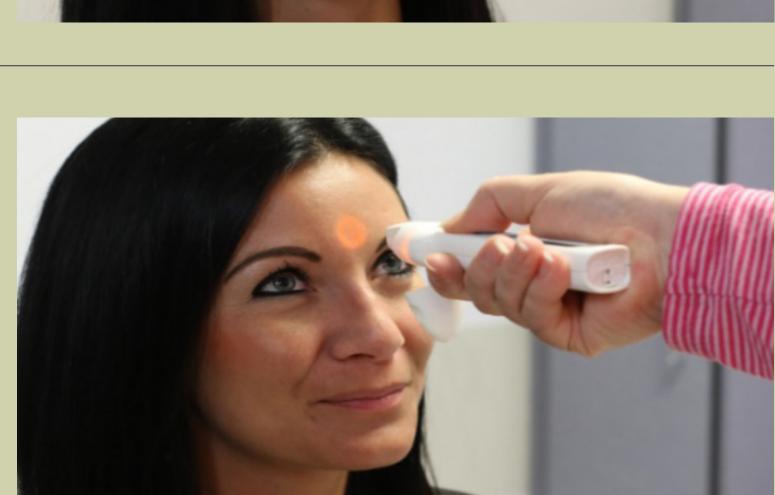
In addition, the study was designed to determine if the inclusion of the ear tap step (Figure 4) when using the temporal artery thermometer improves device accuracy.

Figure 4 Ear tap step for the temporal artery thermometer

Background

Disposable and forehead thermometers are often used in patient care to limit hospital acquired infections despite limited testing of device accuracy in adults. Forehead thermometers, particularly the non-contact thermometer, may not be accurate in adults because of anatomical forehead differences between children and adults.







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Methods



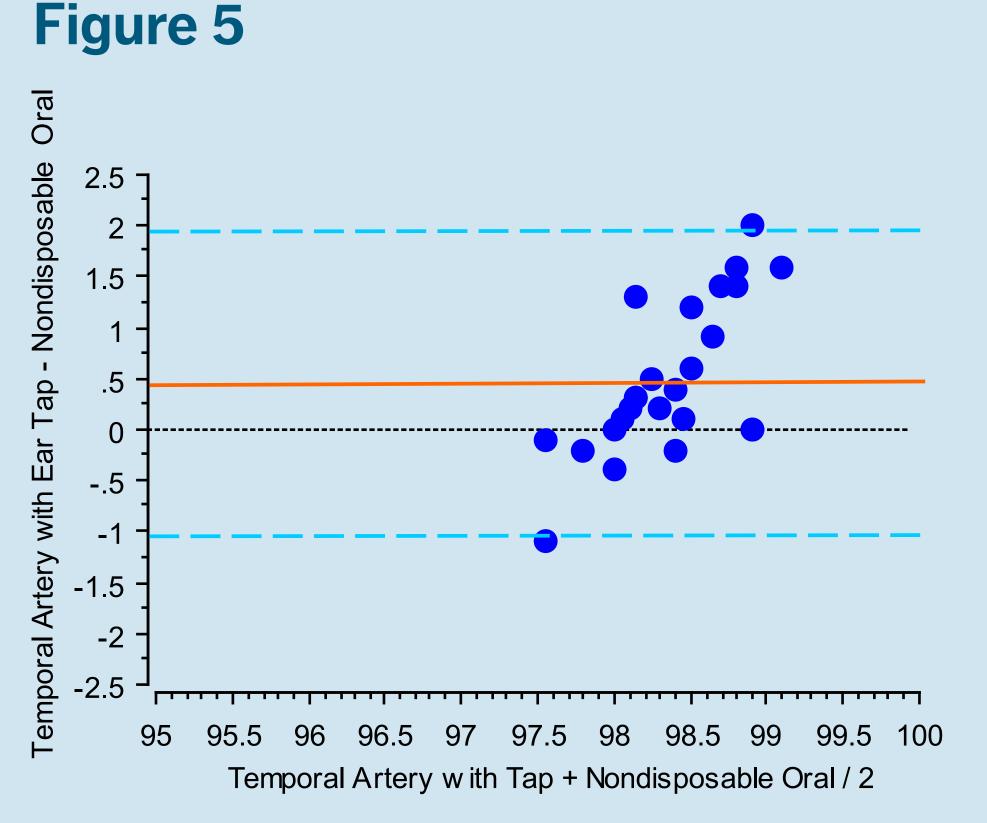


This study was conducted in a 36 bed endoscopy laboratory. The study used a descriptive, methodcomparison design in a convenience sample of elective endoscopy patients. Each subject had temperatures measured once with each temperature device. Device order was randomly assigned for the three non-invasive test devices followed by the reference thermometer.

Results

Bias and precision values in N = 25 afebrile outpatients were within the acceptable range for the temporal artery (Figure 5) and disposable oral (Figure 6) thermometers. The precision value for the non-contact infrared thermometer was within the acceptable level (Figure 7), however, bias (0.66° F) exceeded the *a priori* acceptable level (bias $< + 0.54^{\circ}$ F).

Bias and precision values were found to be smallest when the ear tap step was not compared to inclusion to



Bland-Altman plot of temperature differences (average difference = bias) and limits of agreement (\pm 1.96 SD) in °F between the electronic, nondisposable oral reference temperature device and the temporal artery thermometer with the ear tap step. The acceptable range for clinical equivalency is a bias of $\leq \pm 0.54^{\circ}$ F and precision (± 1.96 SD) of \leq ± 0.90° F.



Data collection by study investigators was completed over a two week period. Differences and limits of agreement were calculated and graphed using the Bland-Altman method, with acceptable levels of bias and precision set a priori at: bias $< + 0.54^{\circ}$ F; precision $< + 0.90^{\circ}$ F.

the ear tap step as recommended by the manufacturer. (Figure 8)

Individual temperature differences between the test and reference thermometers exceeded 1.0° F 4% of the time with the disposable oral electronic thermometer; 32% of the time for the temporal artery thermometer with the ear tap step; 8% of the time for the temporal artery thermometer with no ear tap step; and 40% of the time for the non-contact infrared temperature device.

Figure 6 <u>-</u> 2.5 [·] Ο 1.5 --.5 - \square 95 95.5 96 96.5 97 97.5 98 98.5 99 99.5 100 Disposable Oral + Nondisposable Oral / 2

Bland-Altman plot of temperature differences (average difference = bias) and limits of agreement (\pm 1.96 SD) in °F between the electronic, nondisposable oral reference temperature device and the disposable oral thermometer. The acceptable range for clinical equivalency is a bias of $\leq \pm 0.54^{\circ}$ F and precision (± 1.96 SD) of $\leq \pm 0.90^{\circ}$ F.

Figure 7

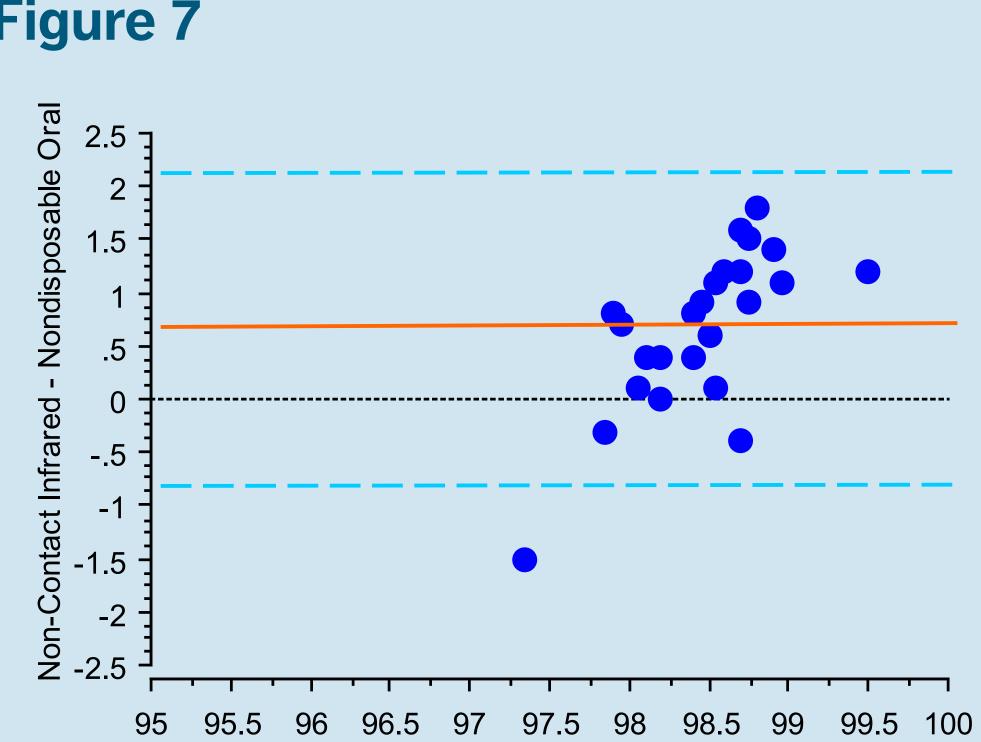


Figure 8 O 2.5]

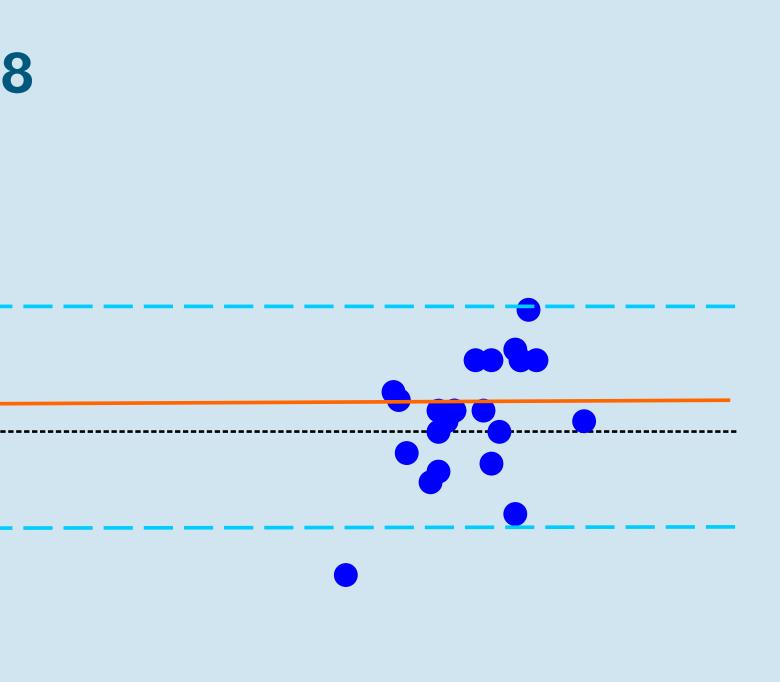
Findings of this study support the use of both temporal artery and disposable electronic thermometers in afebrile outpatients. Based on our results, the noncontact infrared thermometer is not recommended at this time for clinical use.

Additional studies are needed to confirm the bias and precision values of the non-contact infrared thermometer in other patient care situations, particularly in hypothermic and hyperthermic adult patients. In addition, more studies are needed to determine if the ear tap step with the temporal artery thermometer is necessary for improved accuracy. Since this study evaluated only one type of oral disposable and non-contact infrared thermometer, studies of other models of these devices also need to be done.



Results (continued)

Non-Contact Infrared + Nondisposable Oral / 2



95.5 96 96.5 97 97.5 98 98.5 99 99.5 100 Temporal Artery No tap + Nondisposable Oral / 2

Bland-Altman plot of temperature differences (average difference = bias) and limits of agreement $(\pm 1.96 \text{ SD})$ in °F between the electronic, nondisposable oral reference temperature device and the noncontact thermometer. The acceptable range for clinical equivalency is a bias of $\leq \pm 0.54^{\circ}$ F and precision $(\pm 1.96 \text{ SD}) \text{ of } \le \pm 0.90^{\circ} \text{ F}.$

Bland-Altman plot of temperature differences (average difference = bias) and limits of agreement $(\pm 1.96$ SD) in °F between the electronic, nondisposable oral reference temperature device and the temporal artery thermometer with no ear tap step. The acceptable range for clinical equivalency is a bias of $\leq \pm 0.54^{\circ}$ F and precision $(\pm 1.96 \text{ SD}) \text{ of } \le \pm 0.90^{\circ} \text{ F}.$

Conclusions