

Critical appraisal – Diagnostic testing studies

Measurement of body temperature in 300 dogs with a novel noncontact infrared thermometer on the cornea in comparison to a standard rectal digital thermometer.

Introduction	
Are the aims clearly stated?	In the introduction, the authors state that the aims are to assess performance of the NCIT when compared to rectal thermometry, and assess discomfort caused by the two devices.
Methods	
Is the study design suitable for the aims?	A novel thermometer (NCIT) is directly compared to the industry standard for minimally invasive body temperature measurement (digital rectal thermometry) in a large group of dogs presenting to a veterinary clinic. This allows the stated aims to be investigated.
What population of animals was being studied?	Opportunistic sampling of 300 dogs (mixed breed, Labrador and Beagle were the most common breed types) presenting to a single small animal clinic, aged 2.5 months to 17.2 years, including 153 males (97 entire, 56 neutered) and 147 females (77 entire, 70 neutered).
Was this the right sample to answer the objectives?	Yes.
Was an independent blinded gold standard test applied to all subjects?	No. There was no mention of blinding of operators. There is no clear “gold standard” for temperature measurements, previously authors have referred to mercury rectal thermometry as being gold standard, however health and safety concerns have now ruled this method out of European practice. Arterial thermistor or oesophageal thermometry would provide “core” temperature measurement, but these methods are invasive and not appropriate for a non-surgical patient. As digital predictive rectal

	<p>thermometry is most commonly used in veterinary practice, this was an appropriate test to use.</p>
<p>Is it clear what measurements were carried out in the study?</p>	<p>Yes: tolerance of the dogs to the thermometer, experienced operator recorded rectal and NCIT temperature (x 3 per dog), and non-experienced operator recorded rectal and NCIT temperature (x3 per dog).</p>
<p>Were the correct measurements chosen? Do they that reflect (or are they strongly related to) the outcome of interest?</p>	<p>Yes, they were appropriate and related directly to the outcome of interest.</p>
<p>Were previously established validated methods used to make the measurements? (e.g. Glasgow pain score, International Units etc.)</p>	<p>European standard of degrees Centigrade. However, the temperature reference range used to determine normal or abnormal body temperature is not stated, and the ranges for hypothermic, euthermic and hyperthermic patients were different for the rectal temperature and NCIT temperature.</p>
<p>Are the statistical methods described?</p>	<p>Yes, however the authors state they are using a Bland Altman plot to compare rectal to NCIT, but the figure shown is a scatter plot of rectal temperature against NCIT-rectal temperature, this is not a Bland Altman plot so should be re-labelled. It is also standard to compare methods by subtracting the novel method (NCIT) from the standard method (Rectal temperature), so this figure could be misleading.</p>
<p>Was the statistical significance level stated?</p>	<p>Yes, $P < 0.05$</p>
<p>Was the sample size justified?</p>	<p>Power analysis used to determine sample size (198) to detect 0.2°C difference (SD 1 °C), with an error = 0.05, power of 80%.</p>

Was ethical approval obtained?	Yes, government ethics committee.
Overall, are the methods described in enough detail that you could repeat them?	Yes.
Results	
Were the basic data adequately described?	<p>For the study population yes, but the addition of information regarding all breeds, and information regarding the body weight distribution of dogs would improve this.</p> <p>For the results, it is normal to set a limit of agreement between the two measurement devices, e.g. within 0.5 is standard for temperature monitoring. There is no mention of a limit being used to °C assess accuracy.</p>
Do the numbers add up?	Yes.
Are all subjects accounted for?	Yes.
Was the statistical significance (p value) stated in the results?	Yes.
Is this consistent with the methods? (It should be stated in the sample size or power calculation)	Yes.
What were the main findings/key results?	<p>There was poor agreement between NCIT and rectal temperature.</p> <p>Experienced investigators had a repeatability of 0.12 °C when measuring rectal temperature with a digital thermometer, and 0.24 °C when using the NCIT device. This variance increased to 0.14 °C (RT) and 0.29 °C (NCIT) for inexperienced investigators.</p>
Discussion and conclusion	

<p>What do the main findings/key results mean?</p>	<p>There was poor correlation between NCIT and rectal thermometry at high and low body temperatures, meaning both hypothermia and hyperthermia would go undetected.</p> <p>The NCIT caused significantly less discomfort ($P < 0.001$).</p> <p>No significant correlation was found between room temperature and rectal temperatures, but room temperature impact on rectal/NCIT difference was not investigated.</p>
<p>Are the negative findings discussed?</p> <p>How are the negative findings interpreted?</p>	<p>Yes</p> <p>In agreement with the rest of the literature in different animal species, the temperatures recorded by NCIT devices do not appear to reliably represent true core body temperature.</p>
<p>Does the discussion reflect the results?</p>	<p>Yes.</p>
<p>Interpretation</p>	
<p>What are the clinical implications of this study?</p> <p>Are the subjects in the study similar to those in the BET/your own?</p>	<p>NCIT using a Thermofocus 01500 should not be used to assess body temperature in dogs for clinical monitoring.</p> <p>Yes.</p>
<p>General</p>	
<p>Who funded this study?</p>	<p>Not stated, but the NCIT was supplied by the manufacturer.</p>