

Assessing the appropriateness of information on childhood fever in thermometer package leaflets:

a systematic audit of thermometers available in the UK

Abstract

Background

Thermometers are found in most parents' homes, but little is known about the quality and accuracy of the information they provide, nor its consistency with current guidelines for managing fever.

Aim

To compare information included with commonly available thermometers with National Institute for Health and Care Excellence (NICE) guidance for management of feverish illness in children.

Design and setting

Systematic thermometer sampling from UK retailers between February 2013 and May 2013.

Method

Information was extracted from device packaging and leaflets on details and type of thermometer, instructions for use, normal ranges, and fever thresholds cited. This was compared with key parental recommendations from the 2013 NICE guidance on feverish illness in children. Associations were explored between cost of device and level of information.

Results

There were 123 thermometers identified (ranging from £0.99 to £69.99), none of which made explicit reference to NICE guidance. Most ($n = 81$, 65.9%) recommended use at a body site consistent with NICE guidance, but only 17 (13.8%) defined fever using the correct threshold ($\geq 38.0^{\circ}\text{C}$), and few ($n = 12$, 9.8%) included advice on fever management, of which four suggested actions not advised by NICE. There was no association between thermometer cost and provision of information consistent with NICE guidance.

Conclusion

Parents and caregivers have access to a large number of thermometers, yet they lack evidence-based information about fever detection and management, and in some cases contain misleading information. This represents a missed opportunity to disseminate best practices from guidelines for management of fever in children, and thermometer manufacturers are urged to include information consistent with current guidance.

Keywords

consumer health information; general practice; thermometers.

INTRODUCTION

Childhood fever is a frequent cause of parental concern, and one of the most common reasons for parents to seek healthcare advice.¹ Several studies have highlighted that some parents lack knowledge about how to measure temperature in their child, and the optimal way to manage fever.²⁻⁵ This has led to educational programmes using written information that aim to improve management of childhood fever.⁶⁻⁸ These studies suggested that written and video materials can be effective to increase carers' knowledge about fever management, and that their understanding can be significantly enhanced with just a single information session. Guidance for parents on febrile illness, such as the patient.co.uk website, is freely available. The National Institute for Health and Care Excellence (NICE) guideline on the management of feverish illness in children^{9,10} provides evidence-based recommendations for how to measure temperature using specific types of thermometers depending on age, on suggested temperature thresholds that indicate an increased risk of severe illness, and gives specific recommendations on the care of feverish children.

In the authors' (and many of their colleagues') experience as GPs, most parents of young children have at least one thermometer in their home, and although data on ownership rates among UK parents

are lacking, studies from other countries indicate that nearly 90% of parents own thermometers.^{11,12} A wide range of thermometers are available to parents; a decade ago a market assessment report by the Medicines and Healthcare Products Regulatory Agency (MHRA) identified 55 portable thermometers available in the UK,¹³ with prices ranging from 7p to £400, but since then the types and availability of thermometers have expanded further. Given this widespread use of thermometers, the instruction leaflets that accompany them represent a key source of information for parents on thermometer use, interpretation of results, and management of fever. However, little is known about whether thermometer leaflets mirror current evidence-based advice for fever measurement and interpretation.

This study aimed to systematically describe the types of thermometers currently available to parents in the UK, and to determine the extent to which their accompanying information leaflets adhere to current evidence-based guidelines for fever detection and management in children. It was hypothesised that this information represents a key source for parental and carer knowledge and interpretation of temperature and fever.

METHOD

Sampling

Thermometers marketed for use with

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Submitted: 27 October 2014; **Editor's response:** 24 November 2014 **final acceptance:** 27 January 2015.

©British Journal of General Practice

This is the full-length article (published online 26 May 2015) of an abridged version published in print. Cite this article as: **Br J Gen Pract 2015; DOI: 10.3399/bjgp15X685261**

How this fits in

Febrile illness in children is one of the most common reasons for parents to seek healthcare advice. Information from commercially-available thermometers was compared with NICE guidelines on management of febrile illness. Overall, thermometers contain little evidence-based information on fever detection and management. GPs should be cautious about parental interpretation of fever, and device manufacturers should consider modifying their information.

children and available in the UK were purchased from retail and online stores between February 2013 and May 2013. For the retail sample, all pharmacies in Oxford City were identified, and then visited in person, using publicly available lists of all commercial pharmacies, and the outpatient pharmacies of all three hospitals in the city (including the John Radcliffe Hospital, where the Children's Hospital is located) were visited. In addition, all major supermarket chains in Oxford were identified and visited. All outlets were visited repeatedly until no new devices were identified for purchase. For the online sample, thermometers were identified from the websites of pharmacies and supermarkets, as well as from the UK sites of the online retailer amazon.co.uk, and any additional devices that had not been purchased from the retail stores or pharmacies were purchased.

Data extraction

All information included with each thermometer, including leaflets and packaging, was scanned into a database. Two researchers extracted data independently into Microsoft[™] Excel 2010. Where disagreement occurred, consensus was reached by reviewing the thermometer information and further discussion. Data extracted from thermometer packaging and information leaflets was categorised as follows:

- thermometer details: name, type, manufacturer, European conformity (CE) mark, cost;
- instructions for use: recommended body sites, details of how to place and length of time to measure temperature, safety, how to interpret temperature readings, presence of illustrative photos or pictures, advice on overall assessment of a child with fever, and advice on management of fever;

- temperature ranges and fever thresholds; and
- cost in pounds sterling (£) (not including costs of package and postage from the online outlets).

It was then determined whether the information provided with the thermometer was consistent with key recommendations. One author selected the most relevant recommendations from the 2013 NICE feverish illness guideline relevant to management of child fever by parents and/or caregivers, which were then reviewed by experts in primary care including two GP authors and an additional three GPs and/or academic primary care experts. The four key recommendations for parents from the 2013 NICE feverish illness guideline selected were: fever threshold, clinical features to assess in the febrile child, management of the febrile child, and when to seek advice from a healthcare professional. These recommendations were selected as it was considered that they were the most important components of this guideline for informing parents how to assess and manage a febrile child. A binary scale was used to indicate the presence or absence of this information, so a higher score (range 0–4) indicated higher compliance. Where a leaflet did provide information in one of these four criteria, the content of the information was examined to see if it was consistent with the NICE guideline criteria.

Analysis

Descriptive statistics were used to show the variation in thermometers available. To examine the association between thermometer cost and degree of compliance with NICE guidance, the score was plotted against thermometer price and Spearman's rank correlation coefficient was calculated using SPSS (version 19). All other analyses were performed in Microsoft Excel 2010.

RESULTS

Thirty-three thermometers were purchased on visits to 28 pharmacies (including Boots, Lloyds, Rowlands, Superdrug, and smaller independent pharmacies), hospital outpatient pharmacies, and 11 supermarkets (including Tesco, Sainsbury's, Co-Operative, and Waitrose). A further nine thermometers were obtained from pharmacy and retailers' websites and a further 81 from amazon.co.uk. The 123 thermometers were manufactured by a total of 70 different manufacturers, and all except five devices were CE marked. The

Table 1. Types of thermometers identified from survey

	<i>n</i>	%
Digital electronic ^a	55	44.7
Infrared ear ^a and forehead	31	25.2
Forehead chemical strip	19	15.4
Infrared non-contact	10	8.1
Pacifier	6	4.9
Mercury-free	2	1.6
Total	123	100

^aRecommended thermometer by NICE¹⁰

mean cost of a thermometer was £13.80, but prices ranged from £0.99 to £69.99, grouped as <£5 (*n* = 44, 35.8%), £5–10 (*n* = 27, 21.9%), £10–20 (*n* = 22, 17.9%), £20–30 (*n* = 15, 12.2%), to >£30 (*n* = 15, 12.2%).

Description of thermometers

Six main types of thermometer were identified (Table 1). Almost half (*n* = 55, 44.7%) were digital, followed by infrared ear and forehead thermometers (*n* = 31, 25.2%), and forehead (chemical strip) thermometers (*n* = 19, 15.4%). Of these, 81 (65.9%) were types recommended by NICE for use in children <5 years of age, of which just 11 (8.9%) mentioned only body sites recommended for measurement by the NICE guidance, and six (4.8%) suggested specific ages for which the device was suitable. A subset of thermometers that suggested more than one body site for measurement (*n* = 18, 14.6%) further advised a specific site for a more accurate reading, this in most cases was the rectum (*n* = 16, 13%). The most common body sites advised for thermometer placement were axilla, mouth, ear, and rectum (Table 2), in contrast with NICE recommendations for use only at axilla and ear.

Agreement between thermometer advice and NICE guidance

Definition of fever. Most thermometers (*n* = 79, 64.2%) provided no definition for normal body temperature. The remainder indicated a range of definitions: seven stated single values; three specified a normal range based on age; eight stated a range per body site; and eight provided a range for both age and body site. Fewer than

half (*n* = 49, 39.4%) cited a threshold for fever, in only 17 (13.8%) this was the same as the NICE guidance (that is $\geq 38.0^{\circ}\text{C}$),^{10,14} although a further four thermometers had an alarm set at 38.0°C . Some cited lower temperature thresholds, $\geq 37.5^{\circ}\text{C}$ (*n* = 8, 6.5%) and $\geq 37.8^{\circ}\text{C}$ (*n* = 17, 13.8%), while eight (6.5%) also cited higher thresholds, for example 'equal or above 39.0°C ' and 'if the temperature of a child under 6 months old reaches 40.0°C or more'.

Parental interpretation. Most thermometers did not include information about parental or carer judgement of fever (*n* = 104, 84.5%). Of the 19 (15.5%) that did, advice was heterogeneous ranging from 'in case of doubt consult a doctor' to 'you must immediately contact a physician, regardless of the temperature reading if you feel an illness is present'. Two leaflets explicitly recommended against self-diagnosis: 'It is dangerous for patients to diagnose themselves and to treat themselves based on the results of the measurement. Make sure that you obey your doctor's requirements. Self-diagnosis may cause deterioration of disease'.

Advice on managing fever. Most thermometers did not provide any advice on how to manage fever (*n* = 111, 90.2%). Of the 12 that did, eight suggested methods not recommended by NICE (such as bathing and sponging to reduce temperature, clothing removal, and staying in a cool room), the other four suggested methods recommended by NICE including giving antipyretic medication (*n* = 1) and drinking fluids (*n* = 3). One thermometer specifically advised to 'never give aspirin to children under the age of 16 to reduce fever'.

Only 11 (9%) thermometer leaflets noted additional clinical features to assess in a feverish child. Two noted symptoms that are not mentioned in the NICE guidance for parents including agitation, severe sweating, flushed skin, a fast pulse rate, a tendency to collapse, and one mentioned that 'in worst cases if body temperature increases to sufficient level may cause coma or cramps'. One-third (*n* = 44, 35.8%) of thermometers included recommendations on when to seek advice from a healthcare professional, including fever (20, 16.3%), abnormal/increased/prolonged temperature (*n* = 16, 13%), and uncertainty interpreting results (*n* = 4, 3.2%).

Relationship between cost and quality of guidance

Of the four NICE recommendations for

Table 2. Types of thermometers and body sites recommended for use

Type of thermometer	Body sites	<i>n</i>	%
Digital	Axillary ^a , oral and rectal	41	33.3
	Axillary ^a and oral	12	9.8
	Axillary ^a and rectal	2	1.6
	Oral	1	0.8
Chemical strip	Forehead	21	17.1
Infrared	Tympanic membrane ^a and forehead	15	12.2
	Tympanic membrane ^a	11	8.9
	Forehead	8	6.5
	Forehead and ear lobe	2	1.6
	Behind the ear	1	0.8
Pacifier	Axillary and forehead	1	0.8
	Oral	6	4.9
Mercury-free	Axillary, oral and rectal	1	0.8
	Oral	1	0.8
Total		123	100

^aNational Institute for Health and Care Excellence recommended type and site.

parents, half of thermometers ($n = 61$, 49.6%) mentioned none, one-third mentioned ($n = 41$, 33.3%) one, and two thermometers mentioned three. None of the purchased thermometers mentioned all four of the NICE fever recommendations (including the three most expensive thermometers). No significant association was found between thermometer cost and the presence of the four NICE evidence statements ($P = 0.072$).

DISCUSSION

Summary

Based on a rigorous audit of thermometers available from multiple commonly-used sources, parents have ready access to 123 different thermometers in the UK ranging in cost from £0.99 to £69.99, most of which are now digital electronic ear and forehead devices. Nearly three-quarters of the purchased thermometers are types recommended by NICE guidance, namely digital electronic thermometers (44.7%) or infrared ear thermometers (25.2%). However, nearly two-thirds of these thermometers are also marketed for use in body sites not recommended by NICE, such as the forehead, mouth, and rectum.

Almost none of the information or instruction leaflets that accompanied thermometers made explicit reference to current UK evidence-based guidance for parents on temperature measurement and fever management. This represents a huge missed opportunity to educate parents on appropriate identification and management of fever, at a time (when dealing with an acutely ill child) they are likely to be highly receptive to such information. More concerning was that many thermometers contained conflicting and sometimes incorrect information, which is a potential source of confusion for parents, and of harm to children. Even though there is strong evidence for the diagnostic value of parental concern and perceptions of illness, few thermometers mentioned this, and some dismissed it.¹⁵

The threshold used to define fever is important to parents, as it is likely to be a factor in prompting actions such as antipyretic treatment at home or deciding to seek medical advice. However, only a small minority (13.8%) of leaflets recommended fever thresholds in line with NICE guidance. Temperature thresholds to be considered a fever at different sites are heterogeneous (axilla $\geq 37.4^{\circ}\text{C}$, sublingual $\geq 37.6^{\circ}\text{C}$, rectal $\geq 38.0^{\circ}\text{C}$, ear $\geq 37.6^{\circ}\text{C}$),^{16,17} these specific thresholds were not acknowledged by any of the thermometers. Furthermore, devices

did not provide temperature thresholds that may represent a fever at different ages. In contrast, the NICE guideline includes variability by context, site, age, and severity of the condition. Most thermometers did not provide users with normal temperature ranges, and those that did presented a variety of thresholds depending on age and body site. The lack of information on normal temperature ranges and the inconsistency seen in the few instances when information was given may create further confusion, especially as the suggested actions in response to fever were diverse, non-specific, and lacked evidence.

Importantly, more expensive thermometers did not appear to provide more evidence-based information than cheaper devices, suggesting that the deficiencies in current information are not merely a result of manufacturing/distribution costs.

Strengths and limitations

To the authors' knowledge this is the most recent and most thorough survey of thermometers, and the first study to compare the content of information that accompanies thermometers with evidence-based information on management of feverish illness in children from the NICE feverish illness guideline (2013). Attempts were made to obtain thermometers from all sites at which parents are likely to purchase these, including pharmacies, major supermarkets, and a major online retailer. Although the in-person sampling was limited to one geographic location, the addition of websites of the retail stores and the online retailer increases confidence that this sample included most devices available to parents in the UK. The study methods did not allow determination of which thermometers are used most often by parents, nor were attempts made to evaluate thermometer accuracy or reliability.

The key recommendations from the NICE guideline that a group of GP experts considered most relevant to parents were used as a benchmark of 'correct' information. Selection of the four most salient features (that is fever measurement, clinical features to look for, management of fever, and seeking further advice) was not objective and could have caused bias. Other recommendations from this guideline could have been used, or indeed guidelines from other countries. However, it was felt that the NICE guideline to evaluate thermometers that are sold in the UK is a reasonable 'bar'. Data extraction was performed by two

researchers; however, inter-rater reliability was not measured. Finally, thermometers can be purchased for use on adults as well as children, but the decision was made to focus solely on the information presented on children, given that this is the population in whom fever is most commonly measured and which drives much acute care presentation.

Comparison with existing literature

Aside from a MHRA report on thermometer accuracy in the UK from almost 10 years ago,¹³ the authors are not aware of any other studies on thermometer types and their information within or outside the UK.

Parents get information on fever management from multiple sources including friends and family, from the media, via the internet, in written format (leaflets, cards), or from healthcare professionals.¹⁸ It is not known to what extent parents currently use the information enclosed with commercially available thermometers, and whether they retain these information leaflets once they have purchased a new thermometer. From what is known in other areas of parent and patient education, however, easily accessible simple symptom-based messages are regarded as an efficient way to deliver health information.¹⁸

Implications for research and practice

Almost all parents have a thermometer,¹² and commonly use these to measure temperature in their children. The findings of the present study have several potential consequences. First, parents are using types of devices and body sites which are not recommended by NICE, and, presumably, this could lead to inaccurate temperature measurement. Second, having obtained a measurement, the thresholds used to define fever stated by thermometers are often incorrect and may lead to fever being over- or underdiagnosed. Third, having obtained and interpreted a temperature measurement, the current accompanying thermometer information does not provide parents with evidence-based guidance about 'what to do' and how to manage their child's

fever. For example, the lack of emphasis on the value of parental perception and assessment presents a missed opportunity to empower parents that their gut feelings are a predictive feature in the assessment of childhood illness.^{19,20}

This has clear implications for the health system: inaccurate and inappropriate temperature measurement is likely to cause unnecessary parental anxiety and, consequently, drive contacts with healthcare services, risking overburdening health services, or, in contrast, might lead to delayed presentation when false-negative temperatures are noted and parents are falsely reassured.

The present study highlights a huge missed opportunity for disseminating evidence-based guidelines from NICE to parents at a time when they are likely to need this information. Given the anxiety that febrile illness often causes, having access to the key NICE recommendations for parents within thermometer leaflets could be a powerful way to disseminate best practice guidance for parents. There is no need for individual manufacturers to 'reinvent the wheel' and develop their own information leaflets, rather manufacturers are urged to modify the information contained with thermometers to ensure that it is consistent with current guidance. Further research could examine the value of presenting information in this way to parents and whether it is understood or influences their assessment and management of a febrile child.

For guideline developers such as NICE, devices such as thermometers and other commonly-used home devices (for example blood pressure cuffs, glucometers, and pregnancy tests) provide a powerful and currently underused way of disseminating guidance. As the number and range of 'over-the-counter' diagnostic devices grows, particularly those connected with smartphones, there is a pressing need to make sure that not only are these accurate and reliable devices, but also that the advice and actions that they generate are evidence-based.

Funding

Brian D Nicholson is and Jose Hernandez was funded by the National Institute for Health Research (NIHR) School for Primary Care Research (SPCR). The views expressed are those of the authors and not necessarily those of the NHS, the NIHR, or the Department of Health.

Ethical approval

None required.

Provenance

Freely submitted; externally peer reviewed.

Competing interests

The authors have declared no competing interests.

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