Developing interventions to improve parental and carer performance of temperature measurement, fever care and knowledge of feverish illness in children

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Abstract

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Background: Fever is often the initial feature of infectious diseases, which remains a major cause of morbidity and an important cause of mortality in children in the UK, and is one of the most common reasons for children to be taken to a general practitioner. Febrile illness therefore places a considerable burden on children, their families and health care services. The initial disease identification and diagnostic challenge starts at home, with parents and carers differentiating children with suspected serious illness from the vast majority who have self-limiting or minor infections. This thesis aims to understand caregivers' knowledge, beliefs and actions in the existence of a fever in comparison with NICE guideline advice, and suggests some recommendations to improve their knowledge and management of fever.

Method: Four studies were conducted for this thesis. First, a systematic review of 47 studies, including 20,427 participants, was used to understand parents' knowledge regarding interpretation of temperature measurements, actions to manage a fever, and their beliefs. Second, two focus group interviews in primary care, with 9 parents, were used to explore parental views and beliefs on the management of fever and temperature measurement. Third, a thermometer survey, with 123 thermometers, was used to assess the consistency of advice from information contained in commercially available thermometers, with respect to evidence-based guidelines for feverish illness in children. Fourth, a questionnaire survey, in primary care, with 309 participants, was used to find out carer knowledge of temperature measurement and fever management in children 5 years or younger.

Results: Carer knowledge about normal body temperature and fever in children was poor: mild fever was misclassified by many as high. Understanding of what actually constitutes fever ranged widely; carers actively reduced mild fever with antipyretics, used non-recommended methods, and most learned to use a thermometer from its instructions. Most parents did not know what a fever was and believed that it was a harmful condition that may be linked to a more serious disease. Parents wanted to be provided with specific and practical information on the identification of fever and its management. Most of the thermometer information did not include guidance on fever management or thermometer use, did not take into account parental and carer interpretation of fever and disease, however, incorporated unnecessary referrals into health services. Thermometer cost had no influence on the quality of the information provided.

Conclusions: The research presented in this thesis suggests that caregivers often lack basic knowledge on temperature measurement and fever care. The study proposes that a simple NICE guideline based educational intervention may help them to correctly take a temperature measurement while assessing other signs of illness, and allow them to provide appropriate management methods at home, and more importantly, seek further referral where necessary. This may help towards decreasing unnecessary attendances in primary and secondary care.

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Jose Pantaleon Hernandez

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Contents

Chapter 1 Introduction 12

1.1 Overall aims and objectives of the thesis 12

1.2 Structure of the thesis 14

Chapter 2 - Background literature review 14

Chapter 3 - Parental knowledge and understanding of temperature measurement and fever: A systematic review 15

Chapter 4 - Understanding parental knowledge, beliefs and practices on the measurement of temperature and management of fever in children under five years: A focus group interview 16

Chapter 5 - Assessment of different thermometers available to parents and carers: A cross-sectional study of thermometers 16

Chapter 6 - Assessment of parents' and carers' knowledge of temperature measurements and fever in children under five years with feverish illness: A survey 17

Chapter 7 - Conclusions 17

1.3 References 19

Chapter 2 Background literature review 20

2.1. Epidemiology of acute infections in children in developed countries in practices, hospitals and emergency departments 21

2.2 The role of fever in acute infections 26

2.2.1 Fever – Incidence and detection 26

2.2.2 Pathophysiology of fevers 27

2.2.3 Antipyretic drugs and cooling agents to reduce fever and some of their limitations 28

2.2.4 Children and seizures 29

2.2.5 Height and duration of fever and its association with serious infection 30

2.3 Measurement and interpretation of fever in children, by parents and healthcare professionals . 32

2.3.1 Parents assessment of acute illness and concerns in their children, how often they contact healthcare services and who else they can seek care from 32

2.3.2 The importance of fever in children for interactions with health care providers and its influence on the need to seek help or consult a health care professional 33

2.3.3 Use of thermometer in primary care by GPs 33

2.3.4 NICE guideline and site recommendations for thermometer measurements on feverish illness in children 36

2.3.5 Development of the guideline and measurement recommendations 36

2.3.6 Comparison between different methods to measure body temperature 37

2.3.7 The accuracy and practical implementation of different types of thermometers 38

2.3.8 Methods parents use to measure the temperature in children 42

2.3.9 Parental knowledge of temperature measurements 42
2.3.10What is known currently about how well parents can measure and interpret temperature 43
2.3.11 Parental fever beliefs 44
2.3.12 Strength of the underlying evidence 45
2.3.13 Current issue in access to primary health care from children 46
2.4 Main gaps and aims of the study 47
2.4.1 Understand parental and carer knowledge of temperature measurements 47
2.4.2 Carer and parental knowledge, understanding and treatment of fever 48
2.4.3 Understanding parental beliefs about fever 48
2.4.4 Review and investigate the information about temperature measurements in thermometers commercially available 49
2.5 References 50
Chapter 3 Parental knowledge and understanding of temperature measurement and fever: A systematic review 55
3.1 Febrile illness is a common and recurrent source of parental concern 55
3.2 What is known currently about how well parents can measure and interpret temperature 56
3.3 Main gaps and aims of the study 57
3.4 Aim of the study 58
3.5 Method 58
3.5.1 Search strategy and inclusion criteria 58
3.5.2 Quality assessment 59
3.5.3 Data extraction and synthesis 62
3.5.4 Statistical methods 62
3.5.5 Heterogeneity in the reviewed studies 63
3.6 Results 64
3.6.1 Study characteristics 65
3.6.2 Study Quality 72
3.7 Understanding, skills and knowledge of temperature measurements from parents 73
3.7.1 Methods used to measure fever 73
3.7.2 Treatment of fever 75
3.7.3. Definition of fever from parents 77
3.7.4 Parents' perceptions 81
Parental beliefs and actions about fever 81
3.8 Discussion 82
3.8.1 Main findings 82
3.8.2 What it means 82

3.8.3 Implications for practice 83
3.8.4 Implications for further research 84
3.8.5 Limitations 85
3.8.6 Conclusions 85
3.9 References 87
Chapter 4 Understanding parental knowledge, beliefs and practices regarding measurement of temperature and management of fever in children under five years: A focus group interview 90
4.1 Introduction 90
4.2 Rationale for the study 92
4.2.1 Study objectives 93
4.3 Methods 93
4.3.1 Recruitment of parents for the focus group interview 93
4.3.2 Details of the focus group interview schedule 95
4.3.3 Data analysis 96
Ethical considerations 97
4.4 Results 98
4.4.1 Experience and knowledge of fever 98
4.4.2 Management of fever 102
4.4.3 Thermometer use 108
4.5 Discussion 109
4.5.1 How it fits with the existing literature 110
4.5.2 Implication for further research 113
4.5.3 Limitations 114
4.5.4 Conclusion 116
4.6 References 118
Chapter 5 Assessment of different thermometers available to parents and carers: A cross-sectional study of thermometers 121
5.1 Introduction 121
5.1.1 Poor language of the information presented 122
5.1.2 Inaccuracy and coverage of the information contained 122
5.1.3 Lack of user understanding 123
5.1.4 Thermometer packaging and leaflet information 123
5.2 Rationale for the current study 124
5.3 Study objectives 125
5.3.1 Aim 125
5.3.2 Objectives 125

5.4 Study Design and Methods 126
5.4.1 Plan of investigation 126
5.4.2 Thermometer search and acquisition 126
5.4.3 Quality assurance of data extraction 128
5.4.4 Data extraction 129
5.4.5 Data analysis 131
5.5 Results 135
5.5.1 Thermometer features 135
Thermometer advice prior to measurement 140
Thresholds 141
5.5.2 Comparison with NICE advice on thermometer use 142
Fever definition 142
Thermometer price in relation to advice provided 145
5.6 Discussion 147
5.6.1 Clarity of the information presented 148
5.6.2 Fever definition, thermometer accuracy and body temperature in thermometers 149
5.6.3 Fever management considerations, price and relation to advice 150
5.6.4 Implications for further research 151
5.6.5 Limitations 151
5.6.6 Conclusion 152
5.7 References 154
Chapter 6 Assessment of parents' and carers' knowledge of temperature measurement and management of fever in children under five years: A survey 156
6.1 Introduction 156
6.2 Rationale for the study 157
6.2.1 Questionnaire objectives 158
6.3 Methods 158
6.3.1 Participating practices 161
6.3.2 Recruitment of parents and carers for the questionnaire 161
6.3.3 Data analysis 162
Section 1 – Analysis of socio-demographic data 163
Section 2 – Analysis of fever knowledge and management data 164
Section 3 – Any other comments partipants would like to add 167
Ethical considerations 169
6.4 Results 170
6.4.1 Section 1 – Socio-demographic data 170

6.4.2 Section 2 – Fever knowledge and management 172
6.4.3 Section 3 181
Relationship between number of children and knowledge and care of fever 182
6.5 Discussion 187
6.5.1 How it fits in the existing literature 187
6.5.2 The survey and its comparison with research with similar structure 190
6.5.3 Implications for practice 193
6.5.4 Implications for further research 194
6.5.5 Limitations 195
6.5.6 Conclusions 197
6.6 References 198
Chapter 7 Conclusion 201
7.1 Overall aim of the thesis in the context of existing literature 201
7.1.1 Understanding parental and carer knowledge of temperature measurements 202
7.1.2 Parental and carer knowledge, understanding and treatment of fever 202
7.1.3 Understanding parental beliefs about fever 202
7.1.4 Review and investigation of the information about temperature measurements in thermometers commercially available 203
7.2 Summary of research findings 203
7.2.1 Parental knowledge and understanding of temperature measurement and fever: A systematic review 203
7.2.2 Understanding parental knowledge, beliefs and practices regarding measurement of temperature and management of fever in children under five years: A focus group interview 204
7.2.3 Assessment of different thermometers available to parents and carers: A cross-sectional study of thermometers 205
7.2.4 Chapter 6 - Assessment of parents' and carers' knowledge of temperature measurement and management of fever in children under five years: A survey 207
7.3 Implications of research findings for clinical practice and caregivers – Developing interventions to improve parental and carer performance on temperature measurement, fever care and knowledge of feverish illness in children 208
7.4 Implications of research findings for future research 211
7.5 Final conclusions 214
7.5.1 Summary of recommendations 214
7.6 References 219
Appendices 222
Appendix Chapter 2 222
Appendix Chapter 3 222

Appendix Chapter 4 222
Appendix Chapter 5 274
Appendix Chapter 6 277
Publications……293

List of figures

Figure 2.1 – Major cause of mortality in children up to 14 years of age per 100,000.....24
Figure 3.1 – Flow Chart Search the showing selection of included studies 65
Figure 3.2 – Percentage of mothers and fathers.....66
Figure 3.3 – participants that own a thermometer 74
Figure 3.4 – participants that know how to use a thermometer.....75
Figure 3.5 – Percentage of parents able to interpret a fever correctly in children.....79
Figure 3.6 – Studies that define fever as a temperature range.....80
Figure 5.1 – Flow Chart Search showing the search for thermometers.....128
Figure 5.2 – Box Non CE marked thermometers 136
Figure 5.3 – Picture of Braun ThermoScan 5 142
Figure 5.4 – Main fever definitions in thermometer (°C).....143
Figure 5.5 – Advice vs. cost (£).....146
Figure 5.6 – Number of sites measured vs. cost (£).....147
Figure 6.1 – Age of participants.....171
Figure 6.2 – Children's age.....171
Figure 6.3 – What is a high temperature (Question 1) and how high it can get if not treated with antipyretics (Question 2).....173
Figure 6.4 – How low a temperature can cause the harms mentioned in Question 3.....175
Figure 6.5 – How often they will continue measuring temperature in the presence of fever 176
Figure 6.6 – Where did you learn your ideas about fever management 179
Figure 6.7 – At what temperature would you take an infant to a GP or an out-of-hours service 180

List of tables

Table 2.1– Admissions per 100,000 population 22
Table 2.2 – Estimated incidence of serious infection in children per 100,000 23
Table 2.3 – NICE recommendations on thermometers and site measurements 37
Table 3.1 – Study characteristics 67
Table 3.2 – Studies with sponging percentages less or greater than 50% according to study type (questionnaire or interview) 76
Table 3.3 – Wilcoxon signed-rank non-parametric tests 77
Table 3.4 – Studies by main characteristics 80
Table 4.1 – Parent's ethnicity 98
Table 4.2 – Information required by parents 104
Table 5.1 – Basic features/details 129
Table 5.2 – Usage 129
Table 5.3 – Temperature ranges and fever thresholds 130
Consistency with NICE feverish illness recommendation 130
A.1 – Fever definition 130
A.2 – Sites and thermometer types 130
A.3 – Fever management 130
Table 5.4 – Types of thermometers 137
Table 5.5 – Body sites recommended for thermometer use 137
Table 5.6 – Safety information contained in thermometers leaflets 138
Table 5.7 – How long to leave the device in place to take a measurement 140
Table 5.8 – NICE guidance and compliance from thermometer information 144
Table 6.1 – Marital and work status 172
Table 6.2 – What is the greatest harm that high fever can cause to a child 174
Table 6.3 – How often do you give paracetamol or ibuprofen 177
Table 6.4 – Will you use other methods to treat the fever 178
Table 6.5 – Temperature considered high and that prompt carer action 183
Table 6.6 – Percentage of caregivers with different number of children reporting to be worried or very worried 185
Table 6.7 – Percentage of caregivers that worry more versus those who worry less 185
Table 6.8 – Relationship between respondent date of birth and feelings of worry 186
Table 6.9 – Caregivers' understanding of fever and its harmful effects 191
Table 7.1 – NICE guideline advice for feverish illness in children under five years 210

Chapter 1 Introduction

1.1 Overall aims and objectives of the thesis

> *"It is not true that people stop pursuing dreams because they grow old, they grow old because they stop pursuing dreams."*
>
> Gabriel Garcia Marquez (1927 - 2014)

The overall aim of this thesis is to develop an intervention to improve parental and carer performance of temperature measurement, fever care and knowledge of feverish illness in children under the age of 5.

Infection is a major cause of morbidity in children and remains an important cause of mortality in children up to 5 years of age in the United Kingdom.[1] Fever is often the initial feature of infectious diseases, and is one of the most common reasons for children to be taken to a general practitioner (GP). [2] Febrile illness, therefore, places a considerable burden on children, their families and health care services.[3]

Parents care for most acute infections in their children without consulting formal health care providers, and only seek medical attention for a minority of infections.[4] Identification and interpretation of fever in their children are therefore key components of parenting skills, and direct the need and urgency of contact with health care services.[5] Accurate and appropriate temperature measurement and interpretation is important for several reasons. Firstly, the identification of a high fever (e.g. temperature > 40 °C) is associated with an increased risk of a serious infection[6] in children, and it should prompt parents and carers to assess their child for symptoms that are concerning, and if necessary contact a health care provider. Secondly, incorrect measurement (i.e. detection of a fever when none is present) and incorrect interpretation (i.e. inappropriate alarm) can result in unnecessary contact with

clinical services particularly in primary care and emergency care, resulting in an inappropriate use of health care resources. Results from a recorded health diary has highlighted that 60% of children (0 to 14 years) have a period of acute illness within a given three week period.[7] Children in the youngest (0 to 4 years) group reported a tenfold increase in the occurrence of fever than those in the older group (10 to 14 years), and were taken to a GP twice as often as those in the older group. Febrile illness alone accounts for 20% of all visits to the paediatric emergency department.[8] Furthermore, the NICE guideline for feverish illness in children has suggested that approximately 845,000 consultations are for fever without apparent cause. This is a considerable number of attendances, increasing cost and use of healthcare resources that may not always be necessary. Parents and those who care for children ultimately decide when to use further health care resources and this may depend on their, knowledge, beliefs and interpretation of disease, as well as how they interpret temperature measurements. Currently, there may be too many unnecessary health care visits for children, and this is an issue that this thesis aims to address.

Parental and carer interpretations of temperature measurements are influenced by factors such as having access to thermometers, the ability to interpret thermometer readings, information received from informal carers (e.g. relatives and friends) and from formal health services (e.g. National Health Service (NHS) telephone help lines, pharmacies, primary and emergency care services). These factors and how parents interpret temperature measurement may all lead to substantial unnecessary use of healthcare resources.

This thesis therefore tries to identify parental and carer knowledge and beliefs about temperature measurements and fever using a literature review, systematic review methods and primary research.

The specific objectives of this thesis are:

1) To assess evidence that may inform parental knowledge, understanding and skills of temperature measurement and fever management.
2) To assess parental and carer interpretation of temperature measurement for a child and management strategies they use to care for fever according to information from the NICE guideline for feverish illness in children.
3) Review the importance of information contained in thermometer package inserts, and, identification of the range of thermometers commercially available to parents and carers.
4) Through the synthesis and interpretation of the study findings, an intervention designed to improve parental and carer understanding and practice in taking temperature measurements and assessing children with feverish illness, will be proposed.

1.2 Structure of the thesis

This thesis is divided into seven separate sections and the research that follows is described in the following chapters:

Chapter 2 - Background literature review

In this chapter the author reviewed the existing literature regarding parental understanding and knowledge of temperature measurement, and the epidemiology of acute infections in children in primary and emergency care settings. Fever is then related to infection and the importance of accurate temperature readings in children highlighted.

This background concerns the parental use of temperature measurements. Firstly, a review of parental assessment of acute illness in children with a high fever and consequent parental decision whether or not to contact a health care provider. Secondly, there is a review of parental knowledge of temperature measurement, the methods they use to measure it, current parental beliefs on temperature measurement and the significance of fever. In addition, this chapter reviews the evidence on GP's knowledge and skills in relation to temperature measurement and fever. The literature on current parental understanding of how well parents can measure and interpret temperature measurements is reviewed, and this forms the basis for the subsequent systematic review in Chapter 3.

Chapter 3 - Parental knowledge and understanding of temperature measurement and fever: A systematic review

In this chapter, the author conducted a systematic review of the existing literature on parental knowledge and understanding of temperature measurement and fever. This chapter describes the methods and results from this systematic review. In particular the aims of the review were to describe parent's interpretations, knowledge and skills of temperature measurement and fever.

This chapter will examine the understanding that parents have of different levels of fever on thermometers and their importance, and what methods and different types of thermometers they use to measure it. It reviews evidence for accuracy and skills that parents have when taking temperature measurements to see whether they could differentiate normal from abnormal temperature readings, and to understand whether they knew which temperature measurements represented a fever. Different methods to lower elevated body temperature (e.g. medication, sponging) used by parents were also mentioned. Finally, parental perceptions and interpretations of fever were looked at, parental understanding of what

temperature threshold constitutes a fever and possible consequences from fever, and parental management strategies were described.

Chapter 4 - Understanding parental knowledge, beliefs and practices on the measurement of temperature and management of fever in children under five years: A focus group interview

Parents may not always possess correct understanding, or appropriate beliefs, of fever management strategies and methods of temperature taking. Focus group interviews were therefore used to describe and assess parents understanding of fever, and to further understand parental knowledge, beliefs and practices of fever management and temperature taking in children under five years. Data is presented using thematic analysis.

Chapter 5 - Assessment of different thermometers available to parents and carers: A cross-sectional study of thermometers

This chapter reviews over the counter thermometers, which are commercially available to parents and carers, and the accuracy and type of information provided to parents and carers. To the author's knowledge this is the first time, device information has been compared with the NICE guideline to determine the extent to which thermometer package inserts reflect NICE recommendation, as well as definitions of fever and instructions for use.

This chapter hypothesises that information that is commercially available given alongside a thermometer (e.g. the package insert) to measure children's body temperature is not always complete and may not reflect current NHS guidance.

Thermometer packaging and information leaflet were obtained from all thermometers available to buy in the UK including stores, pharmacies and mainstream sources on the internet. The use of different body sites to measure temperature depends on the type of thermometer (some thermometers are designed for use in or on a particular part of the body, whilst others can be used in several sites).

Chapter 6 - Assessment of parents' and carers' knowledge of temperature measurements and fever in children under five years with feverish illness: A survey

This chapter uses a self-administered questionnaire to explore the hypothesis that parents and carers may not always correctly measure temperature or understand what constitutes elevated body temperature in a child.

This chapter describes the results from a survey questionnaire administered to parents and carers at primary care practices; it focuses specifically on parental and carer knowledge of temperature measurement and fever management. The overall aim from this questionnaire is to understand what parents and carers know about fever in pre-school children (under 5 years of age) with a feverish illness, what temperature threshold they considered to be a fever as well as their knowledge of fever management.

Chapter 7 - Conclusions

This chapter summarises the research findings within the context of the existing literature. The implications of the findings for the future parental and carer management of children under 5 with a feverish illness are discussed. This chapter provides a comprehensive summary of findings from the background information, systematic review, focus group

interview, thermometer assessment and questionnaire (chapters 2 to 6). Measures to improve the knowledge of parents and carers about the importance of accurate measurement of body temperature are proposed. Improving the information provided to parents and carers, and their knowledge, could substantially affect referral behaviour, and potentially makes temperature management decisions more appropriate. Furthermore, suggestions for further research in this area are discussed.

The ultimate aim of any intervention is to reduce unscheduled care by minimising avoidable primary care attendances at practices, out–of–hours and A&E Departments and reducing unnecessary admissions in children less than 5 years of age. These conclusions therefore form a proposed intervention beyond the scope of this DPhil.

1.3 References

1. Toft Sørensen H, Møller-Petersen J, Bygum Krarup H, Pedersen H, Hansen H, Hamburger H. Diagnostic problems with meningococcal disease in general practice. *Journal of Clinical Epidemiology* 1992;45(11):1289-93.
2. Thompson M, Mayon-White R, Harden A, Perera R, McLeod Diane and Mant D. Using vital signs to assess children with acute infections: a survey of current practice. *British Journal of General Practice* 2008(58):236-41

3. Clarke S. Use Of Thermometers In General Practice. *BMJ: British Medical Journal* 1992;304(6832):961-63.
4. Houston AM, Pickering AJ. 'Do I don't I call the doctor': a qualitative study of parental perceptions of calling the GP out-of-hours. *Health Expectations* 2000;3(4):234-42.
5. Kramer MS, Naimark L, Leduc DG. Parental fever phobia and its correlates. *Pediatrics* 1985;75(6):1110-3.
6. Van den Bruel A, Haj-Hassan T, Thompson M, Buntinx F, Mant D. Diagnostic value of clinical features at presentation to identify serious infection in children in developed countries: a systematic review. *The Lancet*;375(9717):834-45.
7. Bruijnzeels MA, Foets M, van der Wouden JC, van den Heuvel WJ, Prins A. Everyday symptoms in childhood: occurrence and general practitioner consultation rates. *Br J Gen Pract* 1998;48(426):880-4.
8. Armon K, Stephenson T, Gabriel V, MacFaul R, Eccleston P, Werneke U, et al. Determining the common medical presenting problems to an accident and emergency department. *Archives of Disease in Childhood* 2001;84(5):390-92.

Chapter 2 Background literature review

This chapter will be divided in four parts and cover the following:

2.1 A summary of the epidemiology of infection in children using information from the National Institute for Clinical Excellence (NICE) guidelines for the assessment and initial management of feverish illness in children younger than 5 years, and from data available from the Office for National Statistics (ONS).

2.2 An overview of the role and pathophysiology of fever and in particular the importance of the height and duration of fever and its link to serious infection. An overview of the value of antipyretic medication and cooling agents and their importance in preventing febrile seizures in young children.

2.3 Measurement and interpretation of fever in children by parents and healthcare professionals, looking at: parental assessment of acute illness in children; fever and its relevance for parental interactions with healthcare; use of thermometers in primary care by GPs; NICE recommendations on temperature measurements; accuracy of different types of thermometers and description of types commercially available and finally parental knowledge, skills and beliefs about temperature measurements and fever.

2.4 Identification of the main gaps in the literature will provide an overview of areas where further research is required. These could include: understanding parental knowledge of

temperature measurements, comprehending parental knowledge and care of fever, understanding parental beliefs of fever and exploring information contained in commercially available thermometers.

2.1. Epidemiology of acute infections in children in developed countries in practices, hospitals and emergency departments

An overwhelming number of children attend hospital, and or clinic departments, every year in the United Kingdom.[1] As an example, in one year alone in the A&E department of Nottingham (approximately attending a population of 745,000 individuals, of which children under 15 make up approximately136,000) a total number of 38,982 children were seen.[2] It was estimated that nearly half (48%) of these attendances were associated with infection.[1] The commonest problems reported in children are breathing difficulties (31%), febrile illness (20%), diarrhoea with or without vomiting (16%), abdominal pain (6%), seizure (5%) and rash (5%).[2] Table 2.1, based on data obtained from the Heart of Birmingham Teaching Primary Care Trust, shows the primary diagnosis per 100,000 people.[3] A total of 5,286 admissions per 100,000 occur with viral infection unspecified and acute upper respiratory infections accounting for 30% of deaths, followed by acute bronchiolitis unspecified, acute lower respiratory infection, acute tonsillitis unspecified and viral intestinal infection as major causes of death.

Table 2.1 – Admissions per 100,000 population*

Primary diagnosis	2007/2008	2008/2009	Total	%
Viral Infection Unspecified	383	598	981	16.8
Acute Upper Respiratory Infection	359	430	789	13.5
Unspecified: No infective Gastroenteritis and Colitis	373	369	742	12.7
Asthma Unspecified	214	360	574	9.9
Beta Thalassaemia	299	270	569	9.8
Acute Bronchiolitis Unspecified	228	267	495	8.5
Unspecified Acute Lower Respiratory Infection	230	233	463	7.9
Acute Tonsillitis Unspecified	219	208	427	7.3
Viral Intestinal Infection Unspecified	203	199	402	6.9
Status Asthmaticus	196	188	384	6.6
Total	2704	3122	5286	100

*Data obtained from the Heart of Birmingham Teaching Primary care Trust 2009/2010

Infection is also a major cause of mortality in children, between 0 to 5 years of age; up to 1% of children in the UK will have a serious infection (meningitis, septicaemia, urinary tract infections and pneumonia) (see Table 2.2). Research has highlighted the severity of meningococcal disease or serious bacterial infections.[4-7] Infection is a major cause of mortality in children up to five years of age, with over 100 deaths from infection in children in the first year of life each year in England and Wales.[1] In children aged one to four years of age there are around 30 deaths from infection per year of life. This was highlighted in the NICE guideline for feverish illness in children under 5, showing that infection was second only to congenital defects as a cause of death.[1] The guideline covers the assessment and initial management of children up to 5 years who present with a feverish illness. Relevant published evidence was used to inform the guideline. In areas where important clinical questions were identified but no substantial evidence existed, a two-round Delphi consensus method was used to derive recommendations that involved over 50 clinicians, carers and appropriate stakeholder organizations. Recommendations from the guidance were derived from the evidence statements presented as summaries from the studies reviewed.

Table 2.2 – Estimated incidence of serious infection in children per 100,000

Diagnosis group	Incidence (per 100 000) HES data*
Pneumonia	664
Septicaemia	388
Urinary tract infection	333
Meningitis	30.2
Septic arthritis	9.25
Osteomyelitis	6.17
Other bacterial infection	0.66
Encephalitis	3.65
Kawasaki disease	10.2
Total	1445

*Data obtained from National Episode Statistics in the NICE guideline 2007

A randomised trial of 439 children's birth registers at 3 collaborating centres in the UK[8] (Leicester, Nottingham, and Norwich) estimated that an average of eight infective episodes occurred in "healthy children" within the first 18 months of their life. However, this study did not have a control group to compare results with. The study which recruited a greater number of participants was provided with the intervention of interest (iron supplementation) something that could have had an impact on the results. Furthermore, the study did not acknowledge any limitations, and was funded by a pharmaceutical company which may lead to a reporting bias towards promoting their intervention to introduce iron-fortified formulas in children. According to a public health report from the Heart of Birmingham Teaching Primary Care Trust (HoB tPCT),[9] approximately 1 in 9 (11.2%) of all infant deaths in the West Midlands between 2003 to 2007 were due to infectious diseases. The data also reports the top ten diagnoses for children admitted to hospital, of which six were infective in origin. Overall 3,557 of the 100,000 patients included in the study died with an infectious disease (see Figure 2.1). This report collated data from different local and governmental databases in order to tackle the most important public health issues within UK, in the West Midlands.

Figure 2.1 – Major cause of mortality in children up to 14 years of age per 100,000*

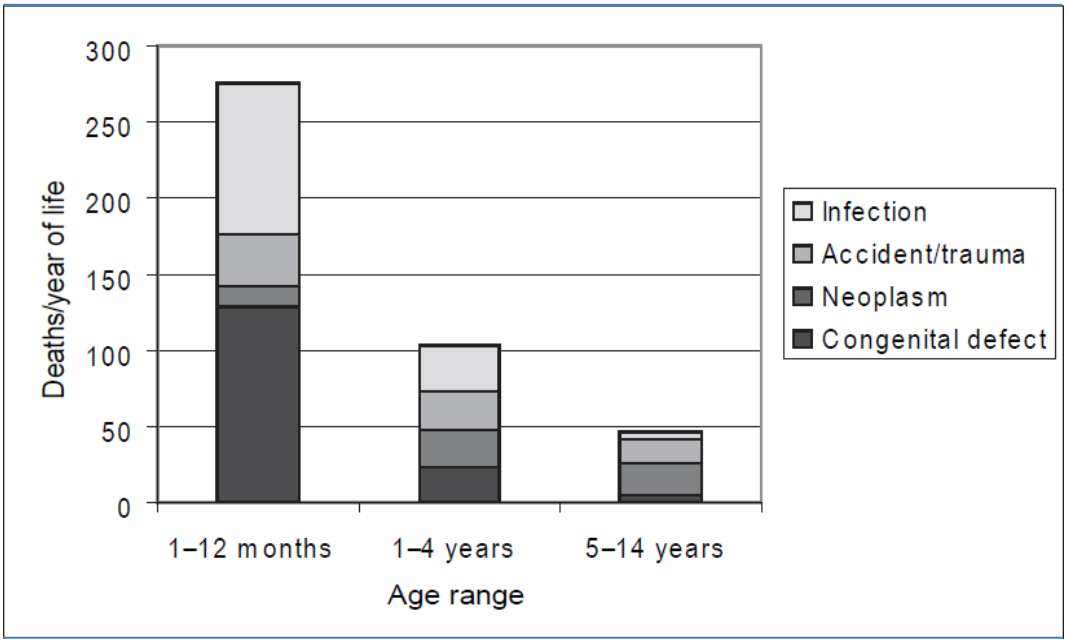


*Figure obtained from page 3 from the Feverish illness in children NICE guideline 2007- Contributors of the four major causative categories of childhood mortality, England and Wales 2004.

Up to 50% of meningococcal diseases are missed during the first consultation with GPs.[4 6 7] However, in most cases fever related illnesses in children are due to self-limiting virus infections where the child will recover without intervention. Moreover, in a small number of cases some serious bacterial illnesses may be present.[10]

The risk of children developing serious bacterial infection over a period of time (incidence) may be more useful than knowing the proportion of cases which develop that infection over specific time periods (prevalence) alone. UK data from children seen at hospital with pneumonia in 2001-2002 found an overall incidence rate of 14.4 per 10,000 in children aged 0-16 years per annum and 33.8 for those aged ≤ 5 years. Boys were more often affected than girls, as were children born between 24-28 weeks.[11] The NICE guideline highlighted that the mean general practice (GP) consultation rate was 3.7 per child per year, and, almost double that rate for children aged less than 4 years, where infections and respiratory disorders made up over 40% of the consultations.

Serious bacterial infections have a high incidence of death. A study in Holland reported[12] that infectious diseases are responsible for 8% of all deaths in children under the age of one year, and 13.6% of deaths in children aged between 1 and 14 years, which is comparable to death rates previously reported in the UK, where most infection related deaths and hospitalisations were due to respiratory disorders.[13]

Most recent information from the hospital statistics data[14] highlighted that between 2008 to 2009 some of the most common infections in children aged between 0 to 14 years admitted to hospital were viral infections. Infections such as herpes viral infection, acute lower respiratory infection and infectious parasitic diseases were characterised by skin and mucus membrane lesions which occurred at various incident rates.

Data on mortality in 2009 (all the certified deaths from England and Wales) from the Office of National Statistics (ONS) revealed the greatest cause of death in children was infectious diseases such as meningococcal infection, septicaemia and other infections.[15] Data from the Health Protection Agency[16] showed that in the South West of England 187 babies under 28 days of age were diagnosed with septicaemia and meningitis between 1998 and 2004 in which boys and girls were equally affected. However, rates of infant mortality due to infections such as meningitis seem to have decreased, the overall estimate for improvement in the odds of death was 59% per year according to a study looking at infected children during a two year period.[17]

In a study from 60 general practices with 106,102 children in England and Wales, it was shown that infectious and respiratory diseases made up over 40% of the diagnoses, with a mean annual consultation rate of almost 4% per year per child.[18] This study did not show differences between genders but found that the highest consultation rates were between children from birth to four years of age. These findings[18] were, however, limited by the fact that practices volunteered for inclusion in the study, and there was low participation by

practices from the inner city with fewer patients from a lower socio-economic background and a low number of different ethnic groups; this may have led to underestimation of the consultation rates and diagnoses. Aggregated data from a whole region, or primary care trust, would therefore be useful to assess the general validity of these findings for other areas.

2.2 The role of fever in acute infections

2.2.1 Fever – Incidence and detection

In the first year of life, infection is the second cause of death after congenital diseases. The NICE guideline[1] reports fever as one of the main reasons for children to visit primary, secondary care and emergency services, particularly when parents believe their children with feverish illness need urgent attendance. These data were based on findings from a prospective cohort study of 13,617 pre-school children living in the south-west of England.[19] From this study high temperature was one of the commonest reasons for children to be taken to the GP. For instance, 40% of parents of children aged less than 6 months, as well as 60% of children aged 6 months to 5 years reported fever as the main reason for attendance at the GPs. High temperature was the second biggest reason for a consultation in children from 6 to 17 months (39%), and one of the most common causes for consultation for one in five children under six months (20%). It is, therefore, an assumption of this thesis that currently too many children may be attending primary care unnecessarily. Caregivers may use healthcare resources more efficiently if they are encouraged to care for children in the home setting when appropriate.

Within the above study parents did not record the number of times that symptoms or consultations took place, the response the rate also decreased significantly with successive questionnaires, which could have affected the results. In addition, the study was limited by an inability to distinguish between primary and secondary care consultations.

The high number of reported cases of elevated temperature in children represents an indication of the importance of measuring temperature and other vital signs in order to detect those signs related to serious bacterial infection.[20 21] These assessments can potentially give clinicians and parents an early indication of ill health. The high frequency of raised temperature and the abnormal physical symptoms (pale/mottled/ashen/blue skin, lips or tongue, no response to social cues etc…) makes it difficult to detect the seriously unwell child from those with a self-limiting illness. However, there are some physical symptoms that can help, such as very unwell appearance or prolonged capillary refill time,[22] that may be related to serious bacterial illnesses in children. The NICE guideline for the clinical assessment of the child with fever[1] recognises different signs to look for in order to ascertain the severity of fever (colour of the skin, child's activity, respiratory rate, hydration and capillary refill). Furthermore, signs such as the quality of children's cry, reaction to parent stimulation, the state variation (whether awake or sleep), colour, hydration and response to social overtures, which were all part of the Yale Observation Scale (YOS),[23] may give an indication of the severity of illness.

2.2.2 Pathophysiology of fevers

Fever is one of the body's immune responses that attempt to neutralise a bacterial or viral infection. It can be caused by many different conditions ranging from benign (e.g. common cold or other self-limiting condition) to potentially serious (e.g. meningitis). Fever (also known as pyrexia or controlled hyperthermia[24]) is a common medical sign characterised by an elevation of temperature above the normal range of 36.5 to 37.5 °C (temperature should be thought as a range rather than a specific value[25]), due to an increase in the body temperature regulatory set points,[26 27] and occurs in response to the presence of bacteria (pyrogens) in the blood. During the rising phase of fever the infected person will often shiver

(to increase heat production), be peripherally constricted (to avoid heat loss), and show physical behaviours to avoid heat loss.

There is evidence of an adaptive host response to infection,[27-29] which has an evolutionary origin. It has been suggested that small elevations in temperature can enhance defence responses,[29] which is important to maintain an immune response. The adaptive value of fever is supported by an association between a rise in body temperature and a decrease in mortality and morbidity during infection.[27-29] These suggestions along with data from evolutionary studies provide strong support for the concept that fever is beneficial during infection in endotherms, ectotherms, vertebrates as well as in invertebrates.

2.2.3 Antipyretic drugs and cooling agents to reduce fever and some of their limitations

The fact that fever may be an adaptation to fight infection may be inhibited by the frequent use of antipyretics to treat it, and these may have some harmful effects on the body's immune system. NICE in its guidelines suggested[1] that antipyretic medication (ibuprofen and paracetamol) should be given to children with fever who are distressed or unwell, but should not be given routinely to all children with a fever.

Studies suggest the use of antipyretic/anti-inflammatory/analgesic drugs, which lead to suppression of fever, may result in increased morbidity and mortality during most infections.[28-30] A study[31] on infected mammals given antipyretic medication, and an infected control group not given antipyretics, showed an increased mortality in the treated group. These results showed that recovery was retarded in the animals treated with antipyretic medication that survived infection. This effect was thought to be due to increased bacterial multiplication during the initial attenuated phase of the infection in the treated animals.[31 32]

A study looking at the adverse effects of aspirin, acetaminophen, and ibuprofen on immune function in humans, found that widely used over-the-counter medications suppressed immune

function, as well as increasing the risk of the severity of infection and duration[33] due to reduced antibody formation. Aspirin and acetominophen in particular were significantly associated with suppression of the serum neutralising antibody response. This can be problematic in populations relatively immunosuppressed or at increased risk for acute infections. It has been suggested[26] that if a reduction in temperature was the only important function of an antipyretic, and ignoring their possible role in reducing inflammation, then the use of antipyretics in children should be more limited.

Using antipyretics and other medications to lower fever in order to prevent adverse effects such as seizures may therefore not be useful. It has been suggested that the use of paracetamol (together with diazepam) does not decrease recurring fits,[34] and even high doses of antipyretics are ineffective to lower temperature and preventing a further new rise in temperature among children hospitalised for febrile convulsions.

External cooling agents, such as rubbing with alcohol, can also be detrimental to children with a fever.[32] Using cold water or ice, which induces shivering, reduces the child's temperature initially but is followed by a rebound increase in temperature, is therefore not recommended.[35]

Antipyretic medication and cooling agents do play a role in relieving pain (such as sore throat, headache or ear pain) and inflammation in children,[26] the NICE guideline also recommends their use in children that are feeling distressed with fever.

2.2.4 Children and seizures

Children are sensitive to high body temperatures and on occasions this can lead to a febrile seizure. Febrile seizures occurring in children between the ages of 6 months to about 3 years of age have an incidence of 2.5% in the USA and Western Europe.[35] Seizures can occur because of hypersensitivity of the hypothalamus. The hypothalamus is responsible, amongst

other functions, for homeostatic core temperature regulation, and in younger children it is still a developing portion of the brain, and can therefore be susceptible to hypersensitive reactions with slight rises in body temperature. The direct cause of a febrile seizure is not known; however, it is usually precipitated by a recent upper respiratory infection or gastroenteritis. A febrile seizure is the effect of a sudden rise in temperature (> 39 °C) rather than being due to a fever that has been present for a prolonged length of time; however, it does not necessarily occur at the onset or the peak of fever, and antipyretics are often used because of concerns over febrile convulsion.

2.2.5 Height and duration of fever and its association with serious infection

Fever in children normally indicates an infection, although not always, and represents a challenge for those in charge of diagnosing the cause and the severity of the presenting condition. In some cases children with serious bacterial infection can be misdiagnosed in primary care.

There are some stronger predictors of serious bacterial infection as mentioned in section 2.2.1, such as very unwell appearance, high temperature, chronic disease and prolonged capillary refill time.[22] Research has suggested that fever of over 12 hours[36] duration is one marker that seemed to be predictive of serious bacterial infection.[10 37] A prospective study of children in primary care showed that a body temperature ≥ 38 °C has a sensitivity over 80% among other tested variables to predict serious bacterial infections.[10 37 38] A systematic review of clinical features, at presentation, examined indicators of serious bacterial infection in children in developed countries.[10] The following features were considered important: reduced consciousness, convulsions, cyanosis, rapid breathing, and slow capillary refill. The study found that a temperature of more than 40 °C had indicatory value as a red flag in a low prevalence settings of serious infection.[10] One of the main strengths of this review was to highlight the difficulty of the diagnostic task for primary care, and hospital clinicians, in

confronting and diagnosing seriously ill children at initial presentation, particularly in countries where serious childhood illness is now rare. Results from another systematic review suggested[39] that the evidence about the predictive value of duration of fever at presentation for serious bacterial infection remains contradictory, and hence inconclusive. This review found only 7 of > 5000 of screened titles of screened studies fitted the review objectives, and none of these included studies were conducted in primary care. Also none of the studies controlled for use of antipyretics or antibiotics (which may have confounded the results). The NICE guideline noted that there was a weak association between the duration of fever and the risk of illnesses (based on 3 studies looking at SBI) as well as a weak relationship between duration of fever and bacteraemia.

The NICE guideline for feverish illness in children looked at several large hierarchies of evidence, mainly level 2 evidence quality studies (well-conducted case–control or cohort studies with a low risk of confounding, bias or chance and a moderate probability that any relationship is causal rather than due to chance). Analyses showed a low sensitivity between 10% to 32%, and a positive predictive value that varied from 4% to 40% for diagnosing serious bacterial infection with increasing body temperatures of ≥ 39 °C in developing countries. The NICE[1] guideline suggested weak evidence to support the relation of duration of fever with serious bacterial infection. These conclusions agree with the suggestions of a recent (2010) systematic review which included 30 studies, and showed that identifying the presence of serious illness from different signs, such as height or duration of fever and other physical signs is difficult, even for professional healthcare staff.[10]

2.3 Measurement and interpretation of fever in children, by parents and healthcare professionals

2.3.1 Parents assessment of acute illness and concerns in their children, how often they contact healthcare services and who else they can seek care from

It is estimated that 20% to 25% of the UK child population receives treatment annually in accident and emergency (A&E) departments. A significant proportion of this workload consists of children with minor illness or injury.[40] According to a UK questionnaire-based survey of 465 children attending A&E, over half of the parents had taken their children directly to A&E for minor illness or injury without consulting primary care.[41] Therefore minor illnesses may on many occasions be sufficiently important for parents to take immediate further action. However, a study looking at maternal employment and children's care[42] found that mothers that more frequently seek medical care for their children, with minor symptoms, were more likely to be employed and require child-care arrangements. Unsurprisingly, it has also been shown[43] that if parents find they are unable to handle child-illness themselves, then medical advice by a physician is considered, as the next point for action.

Parent's common sense actions, in relation to a child's illness, are very relevant as they seek information, try self-treatment or visit a physician.[43] However, their interpretation of a child's illness may often be shaped by their emotional response to a sick child and as result may lead to reduced objectivity. [44]

Research that has looked at the frequency of parental home-treatment of ill children[45] [46] has indicated that 80% of all illnesses are dealt with by parents without reference to the health care system. Parental decisions about whether to take a child for further care, therefore, starts at home.[1] [47] Research has suggested[47] that the strategies chosen are dependent on their

strength of belief on the efficacy of self-management and on a desire to cope, and to take responsibility for their sick child.

Studies indicate that a range of healthcare professionals (including nurses,[48] practice nurses, health visitors[49] and pharmacists[50]) can efficiently care for children with minor illness and a range of other conditions, rendering consultations with GPs or paediatricians unnecessary . These alternative pathways of care,[48 49 50] if adopted, could alleviate perceived use of primary care.

2.3.2 The importance of fever in children for interactions with health care providers and its influence on the need to seek help or consult a health care professional

Fever is important for interactions with health care services; parents perceive GPs' and nurses'[51 52] sources of information, about fever, to be important.

Parental fear of fever may lead to an unnecessary utilisation of health services,[53] particularly in cases where parents overestimate the dangers of fever, and implement clinic visits and inappropriate telephone calls. Such inappropriate use of health-care services can become a burden on emergency care.[5 54] On the other hand parents who incorrectly conclude their child has fever, may seek medical attention or administer medication inappropriately, or use health services resources unnecessarily.

Parental understanding of temperature measurement and its interpretation are therefore clearly important if unnecessary consultations are to be avoided and serious cases are to be appropriately detected and treated.

2.3.3 Use of thermometer in primary care by GPs

To determine both the use and underuse of temperature measurements within primary care as well as community settings, an initial scoping search was undertaken with the aid of a

specialist librarian (NR) using the following terms: "primary care", "general practitioner", "kindergarten", "school", "paediatric", "child", "lower use or misuse", "thermometer", "palpation" and related mesh terms (see Appendix 2.1) to understand GPs use of temperature measurements. The above terms were also used in the following search engines: CINAHL and Embase, finding 150 studies between 1974 and 2011.

Of these only two articles[21 55] were found to be relevant. Both studies attempted to identify the attitudes of general practitioners (GPs) towards using a thermometer as adjunct to the observation of other vital signs.[21]

In a postal survey done in 1991, 145 questionnaires[55] were sent to GP practices in the Surrey catchment area; the response rate was 80%. Questions were asked regarding the types of thermometers used, the accuracy of measurements taken from different sites, correlation between different sites used to measure temperature, the methodology of the measurements and perceived importance of the readings. GPs were also questioned about the perceived importance of temperature measurements in order to check vital signs.

This analysis indicated that GPs generally used mercury thermometers, but there was also a wide variation in their use. Four different groups were identified in terms of thermometer usage: not using them at all, less than once a fortnight, once a week to a fortnight, and twice or more weekly. At the time there was a wide heterogeneity in the measurement methods used and some GPs used more than one method to measure temperature. Furthermore, there was also wide variation in the length of time thermometers were left in place when performing oral measurements. Of the four groups identified: 16% of GPs left the thermometer in place for 30 seconds, 36% for a minute, 30% for 2 minutes and 8% for 3 minutes. The actual optimal time to leave an oral thermometer in place is 3.1 minutes

according to a study carried out on 200 children;[56] of which 100 were less than one year old and 100 were between 1 to 6 years of age.

GPs' perceptions of the importance of temperature also varied as well as the frequency of the measurement. The main limitations of this study[55], for current practice, were the use of mercury-in-glass thermometer which are no longer recommended by clinical guidance[1] (newer studies[52] have shown a predominant use of digital thermometers from parents), its small sample size and because it was a local survey, lack of generalizability.

The second study was a postal survey questionnaire in 2008 sent to 210 GP principals within a 10 miles radius of Oxford. The survey assessed the use of vital signs identifying children with acute infections in primary care,[5] and the use of thermometers in primary care.[55] The study indicated that there is an underuse, and heterogeneous use, of temperature measurements in primary care in children. Heterogeneity of temperature methods and the variable understanding of fever thresholds indicated considerable confusion as to the appropriate management strategy for the individual child.

Approximately 7% of GPs responded they never measured pulse, temperature or respiratory rates to assess vital signs. Significant differences were observed in the methods used to determine fever: 86% used a thermometer, as well as other methods at the same time, 48 % relied on touching the child, and 27% on the parent's observation. Furthermore, different devices were used to measure temperature, which included electronic aural thermometer (85%) and other electronic devices in different body sites (7.2%), as well as practitioners using colour changing-strip to measure temperature (4%).

2.3.4 NICE guideline and site recommendations for thermometer measurements on feverish illness in children

NICE has produced full guidance on temperature measurements in children**.** The guidance was designed for the assessment and initial management of children up to 5 years of age presenting to health services with a feverish illness and covered the following:[1 57]

- Assessment of severity of illness, including how to measure and interpret height of fever.
- Clinical management in primary care, including investigations, use of antibiotics and when to refer for specialist care.
- Initial assessment by paediatric specialists, including appropriate investigation and initial treatment.
- Advice to parent and carers following an encounter with a healthcare professional.

Sites mentioned in the guideline that are normally used for body temperature measurements are mouth, rectum and axilla.[1 57 58] Clinical decisions in most patients are normally based on temperatures measured at peripheral sites (rectum, axilla, mouth, ear and forehead). Rectal measurements provide a good estimate of body temperature while axillary measurements are normally 0.85 °C lower compared to rectal.

2.3.5 Development of the guideline and measurement recommendations

NICE guidance is based on evidence from published research and expert opinion (where limited evidence exists), with the purpose to inform healthcare professionals on how to judge whether the existence of fever in a child may represent a serious illness. Health-care

professionals are advised on whether to observe the child, perform a diagnostic test, start a treatment or refer the child onwards for specialist care following the care pathway suggested.[1]

NICE recommendations on thermometers and site measurements

The guidance recommends not to routinely use the oral and rectal routes to measure the body temperature of children aged 0–5 years. It suggested healthcare professionals who routinely use disposable chemical dot thermometers should consider using an alternative type of thermometer, and that forehead chemical thermometers are unreliable and should not be used by healthcare professionals. It suggested, they should consider reported parental perception of a fever valid and that this should be taken seriously. NICE recommended the use of axillary measurements in babies under 4 weeks, and axillary and tympanic measurements in children 4 weeks to 5 years of age (see Table 2.3).

Table 2.3 – NICE recommendations on thermometers and site measurements

Babies under 4 weeks of age should be measured with an electronic thermometer in the axilla
Children 4 weeks to 5 years of age should be measured with either an electronic or chemical dot thermometer in the axilla or an infrared tympanic thermometer at the eardrum

2.3.6 Comparison between different methods to measure body temperature

An accurate temperature measurement can help confirm the existence or absence of fever. The rectal route has traditionally been the standard method of measurement[59] despite being unpopular with patients and parents. In recent years there has been an increased use of infrared thermometry in both hospital and community practices.[60 61] These devices seem to be comfortable for patients and without complications.[62] Other advantages of infrared tympanic thermometers are a shorter reading time relative to digital thermometers, the minimal risk of infection (no risk of perforation), and acceptability to parents, patients and

healthcare practitioners.[63] However, concerns have been raised about the accuracy of tympanic thermometers.

A systematic review[64] comparing ear with rectal thermometry showed a pooled mean difference between rectal and tympanic temperatures of 0.29 °C (with 95% limits of agreements – 0.74 to 1.32). This systematic review also compared temperatures measured at a number of sites including the oesophagus, the bladder, the axilla, the pulmonary artery as well as core body temperature. Infrared tympanic thermometry exhibited poor agreement with the other methods because of the wide variability of its measurements. The review provided the example, that if a measured temperature in the rectum was 38 °C, the measured temperature at the ear could range anywhere from 37.04 °C to 39.20 °C. A more recent systematic review (2006) looking at the accuracy of infrared ear thermometry showed that specificity and sensitivity were quite heterogeneous within studies;[65] this review argued that even if a cut-off for fever was to be set to 38 °C, because of the different ear thermometer modes used, measured temperatures would vary substantially. Another systematic review[66] (2000) indicated that agreement between temperatures measured at the axilla and rectum in children was low.

Oral and rectal measurement routes seem to be more accurate; however, these routes raise concern about their safety and acceptability and are not routinely used in the UK by healthcare professionals.

2.3.7 The accuracy and practical implementation of different types of thermometers

There are four main types of thermometer available: mercury-in-glass, electronic, chemical and infrared. Recommendations vary depending on the types of thermometer used. However, mercury-in-glass which has been one of the most widely used thermometer types in the past

is no longer recommended in children, due to the risk of breakage and subsequent mercury spillage and poisoning.

A report from the Medicines and Healthcare Products Regulatory Agency (MHRA),[67] in 2005, cited a list of 55 models of stand-alone thermometers (i.e. portable) that are available on the UK market, with a price range from 7 pence to £400. The author could not find a newer report on thermometer types from the MHRA; however, the author is aware of a further three types of thermometer: pacifier thermometers, temporal artery thermometers[68] and mercury free thermometers.[69]

1. **Mercury-in-glass thermometers.** They have been used since their introduction in 1871. They can be used in different body sites such as orally (cannot be used in non-cooperative children or confused adults) in situ for 3.1 minutes and axillary placed for 10 minutes. Is important to note that these thermometers are banned in Europe due to safety issues (see above). Accuracy readings in the laboratory normally range from +0.1/-0.1 °C.

2. **Chemical (phase change) thermometers**. These are composed of small of strips of plastic with cavities which contain a chemical dye which changes with graded temperature variations within a minute of application. Some of these thermometers are designed for a single use (oral and axillary) and others are reusable strips placed on the forehead. The international standard for the maximum error is +0.1/-0.2 °C.

3. **Electronic contact thermometers.** These use an electrical resistance in a metal wire to measure temperature, the higher the temperature the greater the resistance.

Electronic circuitry incorporated in these devices can measure temperature in seconds. They normally have a metal covered thermistor that can be used in the mouth, axilla or rectum. The maximum standard error measured in the laboratory to be +0.1/-0.1 °C.

4. **Infrared sending thermometers**. They contain an optical sensor (normally a thermopile) which detects infrared emissions from any hot object and can measure temperature in a few seconds. Most models obtain their temperature measurements from the tympanic membrane. Some models can measure temperature from the forehead skin and others do not require body contact. There are two current infrared standards for infrared ear thermometer requiring laboratory error to be no more than +0.2 /-0.2 °C.

5. **Temporal artery thermometers.** These use infrared to report a patient's temperature, they are placed on the forehead and then slid across the forehead. Temporal artery thermometers seem to be more accurate than tympanic thermometer in infants, and better tolerated by infants than rectal thermometers; however, they do not seem to have a great sensitivity[70] and seem to be comparably accurate with digital thermometers;[68] they need to be in situ for about 30 seconds.

6. **Pacifier thermometers.** This thermometer is a silicone orthodontic pacifier with a plastic shield, and the pacifier is placed into the baby's mouth. Pacifier thermometers seem to have similar sensitivity but lower specificity than rectal thermometers. They need to be in the baby's mouth to take the measurement for 90 seconds.[71]

7. **Mercury free thermometers.** Contain an expandable non-toxic liquid that changes with temperature; the small change in volume drives the narrow liquid column a relatively long way up the thermometer tube identifying a specific temperature (axillary, rectal and oral use). This thermometer type has been suggested to be a thermometer with similar accuracy and measuring time to mercury-in-glass thermometers, however without the risks of mercury contamination.[69]

   Electronic thermometers and infrared thermometers have the advantage of being accurate, however, they can be complex and expensive.

There is variation in accuracy between measurements with different types of thermometers used.[72] Results suggest that at-home use of tympanic measurements should be used as a screening tool rather than decision aid for patients' follow up. Infrared thermometry is too insensitive to be used as a screening test for fever, but when fever is already suspected, for example by touch, it may be useful as a 'rule in' test. However, studies looking at the accuracy of infrared tympanic temperature readings have shown low specificity, sensitivity and positive predictive values.[73 74] More evidence from the findings, of a systematic review[66] on infrared thermometry, has shown there is not enough evidence to replace current temperature measurement tools (such as electronic thermometers) in primary care with infrared thermometry. Variability in results was also related to the age of the child and the duration of the placement of devices while taking measurements.[64 75]

Temperatures taken at the axilla and infrared thermometers may not be sensitive enough for clinical practice. However, rectal measurements may be optimal when taken in certain circumstances (e.g., neonates or young infants with suspected infection). A 2006 study looking at prospective choices of thermometers showed some differences on accuracy in

different devices. This study also looked at measuring time and price of the devices, suggesting that ultimately the choice of thermometer should be based on robust evidence with regard to the accuracy and reliability of the temperature reading in the clinical setting for which it is intended.[25]

2.3.8 Methods parents use to measure the temperature in children

The objective of this section was to review evidence about the methods parents use to measure temperature in children. Methods included different types of thermometry as well as palm/hand palpation at different body sites.

A search was performed with aid of a specialist librarian using the following terms: "parent", "assessment", "thermometer", "palpation", "touch", "infant" and related mesh terms (see Appendix 2.2) in order to understand parental methods measuring temperature. One study was identified on parental methods for temperature measurement[76] and a further 15 articles[56 71 77-88] were identified through searching bibliographies in the different articles.

The search was performed with no language restriction; however, all the studies found were in English. Search engines used included Pubmed, Embase and Cinahl from 1974 to 2011.

Information included in the above databases, incorporated any evidence from observational studies through to systematic reviews in the three selected topics: Children, parents, thermometry (see results below in section 2.3.10).

2.3.9 Parental knowledge of temperature measurements

In many cases parental touch may be the first assessment of fever when investigating vital signs, therefore it is important to take this method into consideration during further temperature assessments.

A systematic review[82] looking at the accuracy of mothers' touch incorporated 10 cross-sectional studies; this revealed higher levels of sensitivity (89%) than specificity (50%), indicating that maternal touch was more useful in excluding fever rather than in confirming it.

This study showed mothers detected up to 89% of fevers which were also detected by oral or axillary thermometry methods.[82] Review findings indicated great heterogeneity (wide confidence intervals) and suggested more research is needed on the utility of maternal touch to detect fever.[89] From a more subjective point of view, it may be important to understand parents' concerns when their children are ill and, in particular, their views about fever.

2.3.10 What is known currently about how well parents can measure and interpret temperature

A correct temperature measurement is an important sign, identifying and defining a child's vital signs, and may help in detecting life threatening conditions such as serious bacterial infections,[5 54 90] and help defining the height[10] and duration[36] of fever in conjunction with other signs.

Parental ability to read a thermometer has been found to be poor[91] as well also has their interpretations of fever.[92-96] A 1998 study suggested[93] that almost half of the parents used a liquid crystal forehead thermometer despite its poor accuracy. Most could not correctly use a glass thermometer, and about a third initiated treatment of their children at temperatures below the fever threshold. Research has highlighted parental beliefs have led to the predominant use of forehead strips despite lack of hospital use due to inaccuracy.[93]

Half of the parents do not know how long to leave a thermometer in situ before reading the measurements. Furthermore, parents will interpret a temperature of less than 38 °C as a significant fever,[51 95-99] and may therefore be treating children inappropriately. A survey of

relatively well-educated parents[100] showed between 21% to 32% will treat their children with antipyretics even when their temperature was within a normal range.[101 102] Parental use of antipyretics may also be imprecise, with doses either too low, too high or of incorrect frequency.[103 104]

2.3.11 Parental fever beliefs

An early study[92] in 1980 suggested parents were very worried about fevers and therefore would often treat children over aggressively. This study described unrealistic fears of fever using the term "fever phobia", and suggested guidelines were required for parents to understand fever better. The NICE guideline highlights[1] the concern elicited by parents when children have a fever, which include, parental apprehension of potential harm, indicating that fever, cough and meningitis were the main concerns of parents when their child became acutely ill.[105]

Parental perceptions of possible harm from fever reported in the literature include risk of fits or brain damage in children with fever,[53 93 95 96 106-108] death,[53 92 93 95 106 108] dehydration,[53 92 95 106 108] blindness,[92 95 108] coma,[92 95 108] becoming really sick, worsening of the condition, delirium, fainting, vomiting and many other harms have been cited, regardless of the country of origin. Parental feelings of phobia have been widely documented[53 92 95] all around the world (studies from North and South America, Middle East, Asia, Australia and Europe). Results are consistent from the first study in 1980[92] when the term "fever phobia" was first described to very recent studies;[90] many parents report believing fever to be harmful and being very worried about the perceived harmful effects, despite reports of the benefits of mild to moderate fever in the medical and scientific literature.[28 29] Such apprehensions are important, because responses to apparent fever and may lead some parents to believe that fever can rise to dangerous levels if not treated,[96] thus resulting in inappropriate treatment.

Recent studies have shown a trend for worrying about febrile convulsions;[95 108 109] however, the main concerns remain the same amongst parents: brain damage, febrile convulsions and death. Parents feared that unrecognised disease could have serious consequences or even cause death. Parents also worried about failing to recognise a serious disease.

Information about parental decisions in seeking medical care are important; some studies have shown that the main parental sources of knowledge about fever in children were doctors,[51 52 110] nurses, relatives and friends, reading, internet, pharmacists, healthcare staff and others.[51 52] A qualitative study highlighted[105] that parental concerns, when children are ill, were influenced by the perceived threat of illness, and also anxieties about fever, coughs and the possibility of meningitis. Parental anxiety was augmented by the knowledge that non-specific symptoms could lead to more serious illnesses. Parental concern seemed to increase with the perception of the symptoms of illness hurting the child, predictors for parental concern about fever seemed to persist across the literature.[95]

2.3.12 Strength of the underlying evidence

Evidence of parental interpretation of temperature measurement and care of fever has been mentioned in many studies. Most of these were observational, involving quantitative or qualitative design and the majority were questionnaire-based cross-sectional studies.[95] Most questionnaire studies used different questions to understand parental knowledge, did not incorporate the same socio-demographic questions and were not always carried out in the same settings (i.e. community clinics or pediatric emergency department). Questionnaires may be a feasible way to collect a large amount of data from participants in a relatively short period. Survey data may also be relatively easy to quantify, however, it can incorporate specific sources of bias,[111] such as not being able to identify respondents with different views to those who responded (non-response bias), participants responses may vary from an accurate answer (response bias) or using participants from a limited type of settings or

settings that may have an effect on the survey outcome (selection bias). Qualitative research can be a comprehensive way to understand parental beliefs of fever, however, it may also pose threats to the validity of research, particularly if studies did not use an appropriate recruitment strategy. Qualitative studies may try to enhance the sample coverage and provide a framework for analysis (purposive sampling), refine coding frameworks (multiple coding), corroborate or refine findings (triangulation) or refute interpretations (respondent validation).[112]

Although the studies found in the literature review showed evidence of parental lack of understanding of temperature measurement and care of fever, there seemed to be a lack of high quality evidence. The NICE guideline provided evidence on the knowledge of feverish illness that carers should possess, however, research found within this literature review did not find many relevant studies and no other evidence-based guideline. Furthermore, no systematic reviews or randomised control trials (RCT),[113] the gold standard for high quality evidence, were found about parental knowledge and management of feverish illness.

2.3.13 Current issue in access to primary health care from children

Research found in the literature review has shown that parental understanding and related care of fever can, on occasions, be inadequate to treat an illness.

Fever is a very common reason to seek health care; as a nurse-led telephone triage showed that it was the concern in 52% of all calls about children aged less than 12 months and 64% of all calls about children aged 1-5 years.[114] Feverish illness is also one of the most common reasons for children to be seen in hospitals, and is a leading cause of admission to children's wards. The NICE guideline suggests that approximately 845,000 consultations are for fever lacking an apparent cause; it highlights the cost of antipyretics, and devices used for management. Given that the initial decision to consult healthcare services occurs in the home

setting, there is a need to improve the early decision making of parents. Improving the education and knowledge of fever and its management could have a significant impact on use of services.

2.4 Main gaps and aims of the study

The literature reviewed in this chapter highlights three important issues that need to be addressed: 1) that parental understanding of temperature measurements are frequently inaccurate, 2) their ability to interpret signs of fever through physical symptoms (palpation method or child behaviour) can be misleading, and 3) their ability to read a thermometer and interpret temperature thresholds that constitute a fever can be poor, altogether leading to an inaccurate interpretation of fever. It was also shown in this literature review that parental ability to interpret symptoms of feverish illness may on occasion create exaggerated perceptions of harm, which may in turn be detrimental for child care. Where beliefs of harm from fever exist unnecessary strain may be placed on primary care or emergency services. Parents are still overly worried for their children when fever manifests itself.[95] These parental beliefs may create a burden on the health system, or in cases where fever is wrongly interpreted may be harmful for the health of the child through inappropriate management (excessive or deficient medication, harmful practices such as rubbing alcohol or ice).

The main gaps identified in the literature that this study will try to cover are the following:

2.4.1 Understand parental and carer knowledge of temperature measurements

Research[53] [95] has suggested limited parental knowledge of temperature measurements. Appropriate skills and interpretation in the use of a thermometer, together with an

understanding of other physical signs, may help parents to better identify when a child may have a high temperature. If caregivers can correctly identify a child's high body temperature they may choose appropriate further action.[93 115]

Based on these observations it is hypothesised that parents and carers may not always have or use a thermometer, and even in cases where thermometers are owned they may be unused or used incorrectly.

These hypotheses were systematically examined and presented in Chapter 3 through the findings of a systematic review and in Chapter 6 through the use of a self-administered survey questionnaire to parents and carers. These two studies also endeavoured to assess the different temperature thresholds that parents and carers think constitute a fever and what type of thermometers they believe are appropriate.

2.4.2 Carer and parental knowledge, understanding and treatment of fever

Parent's understanding of what temperature threshold constitutes a fever varies across the literature,[92 93 95] and this knowledge may have a direct impact on the care of children with feverish illness.[51 95 96]

It is currently not fully understood how parents and carers know about fever and its management and it was hypothesised that parental and caregiver knowledge and care of a child's fever may not always be appropriate. This was analysed with a systematic review in Chapter 3 and tested with a questionnaire survey of caregivers in Chapter 6.

2.4.3 Understanding parental beliefs about fever

Published studies indicate parents have unrealistic beliefs about fever.[52 92]

Exaggerated beliefs of harm from fever have been detailed within the literature from very early studies,[92] to the most recent,[90] and these views are spread worldwide. Fear of fever

causing extreme harm (death, febrile convulsions, retardation or blindness) are detrimental towards parental management of feverish illness, whereas appropriate parental beliefs about fever may increase the likelihood of adequate management of feverish illness in children.[53]

These hypotheses were examined in Chapter 4, through a qualitative study interviewing parents.

2.4.4 Review and investigate the information about temperature measurements in thermometers commercially available

Parental knowledge of how to take a child's temperature correctly or use a thermometer on a child appears to be deficient,[91 116] and there seems currently to be a limited amount of research on this topic.

The hypothesis that thermometer packaging and leaflets may not provide accurate information for parents and caregivers, jeopardising their ability to correctly manage a fever, was tested in Chapter 5. This was carried out through a cross-sectional study to investigate the information that is provided by thermometer leaflets and packages, available to parents and carers, on the market. This study also determined how this information may be useful in educating parents on how to best take a temperature measurement and to better understand the information provided on temperature threshold that constitutes a fever.

2.5 References

1. NICE. Assessment and initial management of feverish illness in children younger than 5 year. *BMJ* 2007;334(7604): 1163–1164.
2. Armon K, Stephenson T, Gabriel V, MacFaul R, Eccleston P, Werneke U, et al. Determining the common medical presenting problems to an accident and emergency department. *Archives of Disease in Childhood* 2001;84(5):390-92.
3. Heart of Birmingham Teaching Primary Care Trust N. Public Health Report 2009/2010, 2010.
4. Thompson MJ, Ninins N, Perera R, et al Clinical recognition of meningococcal disease in children and adolescents. *Lancet* 2006;367:397–403.
5. Thompson M, Mayon-White R, Harden A, Perera R, McLeod Diane and Mant D. Using vital signs to assess children with acute infections: a survey of current practice. *British Journal of General Practice* 2008(58):236-41
6. Toft Sørensen H, Møller-Petersen J, Bygum Krarup H, Pedersen H, Hansen H, Hamburger H. Diagnostic problems with meningococcal disease in general practice. *Journal of Clinical Epidemiology* 1992;45(11):1289-93.
7. Nadel S, Britto J, Booy R, Maconochie I, Habibi P, Levin M. Avoidable deficiencies in the delivery of health care to children with meningococcal disease. *Journal of Accident & Emergency Medicine* 1998;15(5):298-303.
8. Singhal A, Morley R, Abbott R, Fairweather-Tait S, Stephenson T, Lucas A. Clinical Safety of Iron-Fortified Formulas. *Pediatrics* 2000;105(3):e38.
9. Trust HoBTPC. Public Health Report 2009/2010. 2010.
10. Van den Bruel A, Haj-Hassan T, Thompson M, Buntinx F, Mant D. Diagnostic value of clinical features at presentation to identify serious infection in children in developed countries: a systematic review. *The Lancet*;375(9717):834-45.
11. Harris M, Clark J, Coote N, Fletcher P, Harnden A, McKean M, et al. British Thoracic Society guidelines for the management of community acquired pneumonia in children: update 2011. *Thorax.* 2011;66(Suppl 2):ii1-23. doi: 10.1136/thoraxjnl-2011-200598.
12. Health TFafca. Care-and-health. The Flemish agency for care and health, (agency of the Flemish ministry for health and family). 2007.
13. Wilson D, Bhopal R. Impact of infection on mortality and hospitalization in the North East of England. *Journal of Public Health* 1998;20(4):386-95.
14. Statistics OHE. Primary diagnosis summary. 2011.
15. ONS. Table 5.1 Deaths: underlying cause, sex and age group, 2009: Chapter I Certain infections and parasitic diseases. 2009.
16. Oliver I RS. First in line for infection the South West: Bulletin 3. 2005.
17. Booy R, Habibi P, Nadel S, de Munter C, Britto J, Morrison A, et al. Reduction in case fatality rate from meningococcal disease associated with improved healthcare delivery. *Archives of Disease in Childhood* 2001;85(5):386-90.
18. Sonia Saxena AM, Michael Jones. Socioeconomic differences in childhood consultation rates in general practice in England and Wales: prospective cohort study. *British Medical Journal* 1999;318.
19. Hay AD, Heron J, Ness A. The prevalence of symptoms and consultations in pre-school children in the Avon Longitudinal Study of Parents and Children (ALSPAC): A prospective cohort study. *Family Practice* 2005;22(4):367-74.
20. Thompson M, Mayon-White R, Harnden A, Perera R, McLeod D, Mant D. Using vital signs to assess children with acute infections: a survey of current practice. *British Journal of General Practice* 2008;58(549):236-41.
21. Thompson M, Mayon-White R, Harnden A, Perera R, McLeod D, and Mant D. Using vital signs to assess children with acute infections: a survey of current practice. *British Journal of General Practice* 2008;58(549):236–41.
22. Craig JC, Williams GJ, Jones M, Codarini M, Macaskill P, Hayen A, et al. The accuracy of clinical symptoms and signs for the diagnosis of serious bacterial infection in young febrile children: prospective cohort study of 15 781 febrile illnesses. *BMJ* 2010;340.

23. Paul L. McCarthy MRS, Sydney Z. Spiesel,Thomas F. Dolan, Brian W. Forsyth, Thomas G. DeWitt, Howard D. Fink, Michael A. Baron, Domenic V. Cicchetti. Observation Scales to Identify Serious Illness in Febrile Children. *Official Journal of the American Academy of Pediatrics* 1982;70:802 -09
24. Axelrod YK, Diringer MN. Temperature Management in Acute Neurologic Disorders. *Neurologic Clinics* 2008;26(2):585-603.
25. Crawford DC, Hicks B, Thompson MJ. Which thermometer? Factors influencing best choice for intermittent clinical temperature assessment. *Journal of Medical Engineering & Technology* 2006;30(4):199-211.
26. Aronoff DM, Neilson EG. Antipyretics: mechanisms of action and clinical use in fever suppression. *The American Journal of Medicine* 2001;111(4):304-15.
27. Kluger MJ. Fever: role of pyrogens and cryogens. *Physiol Rev* 1991 71(1):93-127
28. Kluger MJ, Kozak W, Conn CA, Leon LR, Soszynski D. The adaptive value of fever. *Infectious disease clinics of North America* 1996;10(1):1-20.
29. Kluger MJ, Kozak W, Conn CA, Leon LR, Soszynski D. Role of Fever in Disease. *Annals of the New York Academy of Sciences* 1998;856(1):224-33.
30. D. S. The pathogenesis and the adaptive value of fever. *Postepy Hig Med Dosw* 2003;57(5).
31. Vaughn LK, Veale WL, Cooper KE. Antipyresis: Its effect on mortality rate of bacterially infected rabbits. *Brain Research Bulletin* 1980;5(1):69-73.
32. Kurosawa S, Kobune F, Okuyama K, Sugiura A. Effects of Antipyretics in Rinderpest Virus Infection in Rabbits. *Journal of Infectious Diseases* 1987;155(5):991-97.
33. Graham NMH, Burrell CJ, Douglas RM, Debelle P, Davies L. Adverse Effects of Aspirin, Acetaminophen, and Ibuprofen on Immune Function, Viral Shedding, and Clinical Status in Rhinovirus-Infected Volunteers. *Journal of Infectious Diseases* 1990;162(6):1277-82.
34. Uhari M, Rantala H, Vainionpää L, Kurttila R. Effect of acetaminophen and of low intermittent doses of diazepam on prevention of recurrences of febrile seizures. *The Journal of Pediatrics* 1995;126(6):991-95.
35. Waruiru C, Appleton R. Febrile seizures: an update. *Archives of Disease in Childhood* 2004;89(8):751-56.
36. Pratt A, Attia MW. Duration of fever and markers of serious bacterial infection inyoung febrile children. *Pediatrics International* 2007;49(1):31-35.
37. Van den Bruel A, Aertgeerts B, Bruyninckx R, Aerts M, Buntinx F, Hall H. Signs and symptoms for diagnosis of serious infections in children: a prospective study in primary care. *British Journal of General Practice* 2007;57(540):538-46.
38. Van den Bruel A, Aeertgerts B, Bruyninckx R, Aerts M, Buntinx F. Signs and symptoms for diagnosis of serious infections in children: a prospective study in primary care. *British Journal of General Practice* 2007;57(540):538–46.
39. Gijs Elshout MM, Johannes C van der Wouden, Bart W Koes and Marjolein Y Berger Duration of fever and serious bacterial infections in children: a systematic review. *BMC Family Practice* 2011;12:33.
40. B M Phillips WR. Paediatrics in the accident and emergency department. *Archives ofDisease in Childhood* 1992;67.
41. Hendry SJ, Beattie TF, Heaney D. Minor illness and injury: factors influencing attendance at a paediatric accident and emergency department. *Archives of Disease in Childhood* 2005;90(6):629-33.
42. Horwitz SM, Horwitz RI, Morgenstern H. Maternal employment, maternal care and pediatric visits for minor acute illnesses. *Journal of Clinical Epidemiology* 1993;46(9):981-86.
43. Ertmann RK. What makes parents consult a physician?: Parents' experience with their sick child. 2007.
44. Ertmann RK, Söderström M, Reventlow S. Parents' motivation for seeing a physician. *Scandinavian Journal of Primary Health Care* 2005;23(3):154-58.
45. Teng T. Background problems in pediatric emergency care. *Current situation an perspective on pediatric emergency care* 2004:17-19.

46. Bruijnzeels MA, Foets M, van der Wouden JC, van den Heuvel WJ, Prins A. Everyday symptoms in childhood: occurrence and general practitioner consultation rates. *Br J Gen Pract.* 1998;48(426):880-4.
47. Houston AM, Pickering AJ. 'Do I don't I call the doctor': a qualitative study of parental perceptions of calling the GP out-of-hours. *Health Expectations* 2000;3(4):234-42.
48. Marsh GN, Dawes ML. Establishing a minor illness nurse in a busy general practice. *BMJ* 1995;310(6982):778-80.
49. Pritchard A, Kendrick D. Practice nurse and health visitor management of acute minor illness in a general practice. *Journal of Advanced Nursing* 2001;36(4):556-62.
50. Tim Hammond JCaRH. Patients' use of GPs and community pharmacists in minor illness: a cross-sectional questionnaire-based study. *Family Practice* 2004;21 (2).
51. Al-Abdel Jalil HK, Jumah NA, Al-Baghli AA. Mothers' knowledge, fears and self-management of fever: A cross-sectional study from the capital governorate in Kuwait. *Kuwait Medical Journal* 2007;39 (4):349-54.
52. Gunher Arica S, Arica V, Onur H, Gülbayzar S, Dağ H, Obut Ö. Knowledge, attitude and response of mothers about fever in their children. *Emergency Medicine Journal* 2011.
53. Kramer MS, Naimark L, Leduc DG. Parental fever phobia and its correlates. *Pediatrics* 1985;75(6):1110-3.
54. Thompson MJ, Ninis N, Perera R, Mayon-White R, Phillips C, Bailey L, et al. Clinical recognition of meningococcal disease in children and adolescents. *The Lancet*;367(9508):397-403.
55. Clarke S. Use Of Thermometers In General Practice. *BMJ: British Medical Journal* 1992;304(6832):961-63.
56. Chaturvedi D, Vilhekar KY, Chaturvedi P, Bharambe MS. Reliability of Perception of Fever by Touch. *Indian journal of pediatrics* 2003;70 (11):871-73.
57. NICE. Feverish illness in children: Assessment and initial management in children younger than 5 years (guidance), 2013.
58. Thompson M. Extract of DPhil Thesis. 2007.
59. Robinson JL, Seal RF, Spady DW, Joffres MR. Comparison of esophageal, rectal, axillary, bladder, tympanic, and pulmonary artery temperatures in children. *The Journal of Pediatrics* 1998;133(4):553-56.
60. B G Silverman WRD, and J D Rubin. The use of infrared ear thermometers in pediatric and family practice offices. *Public Health Rep* 1988;113(3):268–72.
61. Stewart JV, Webster D. Re-evaluation of the tympanic thermometer in the emergency department. *Annals of Emergency Medicine* 1992;21(2):158-61.
62. Alexander D, Kelly B. Responses of children, parents, and nurses to tympanic thermometry in the pediatric office. *Clinical Pediatrics* 1991;30 (4 SUPPL.):53-56.
63. Barber N KC. Reactions to tympanic temperature measurement in an ambulatory setting. *Pediatric nursing* 1989;15(5):477-81.
64. Craig JV, Lancaster GA, Taylor S, Williamson PR, Smyth RL. Infrared ear thermometry compared with rectal thermometry in children: a systematic review. *The Lancet* 2002;360(9333):603-09.
65. Dodd SR, Lancaster GA, Craig JV, Smyth RL, Williamson PR. In a systematic review, infrared ear thermometry for fever diagnosis in children finds poor sensitivity. *Journal of Clinical Epidemiology* 2006;59(4):354-57.
66. Craig JV, Lancaster GA, Williamson PR, Smyth RL. Temperature measured at the axilla compared with rectum in children and young people: systematic review. *BMJ* 2000;320(7243):1174-78.
67. D Crawford Ng, S Wetworth. Thermometer review: UK market survey. 2005.
68. Callanan D. Detecting Fever in Young Infants: Reliability of Perceived, Pacifier, and Temporal Artery Temperatures in Infants Younger Than 3 Months of Age. *Pediatric emergency care* 2003;19(4):240-43.
69. Smith L. Reexamining age, race, site, and thermometer type as variables affecting temperature measurement in adults - A comparison study. *BMC Nursing* 2003;2(1):1.

70. Greenes DS, Fleisher GR. Accuracy of a Noninvasive Temporal Artery Thermometer for Use in Infants. *Arch Pediatr Adolesc Med* 2001;155(3):376-81.
71. Callanan D. Detecting fever in young infants: Reliability of perceived, pacifier, and temporal artery temperatures in infants younger than 3 months of age. *Pediatric Emergency Care* 2003;19 (4):240-43.
72. Devrim I, Kara A, Ceyhan M, Tezer H, Uludag AK, Cengiz AB, et al. Measurement Accuracy of Fever by Tympanic and Axillary Thermometry. *Pediatric emergency care* 2007;23(1):16-19 10.1097/PEC.0b013e31802c61e6.
73. Lanham DM WB, Klocke E, Jennings M. Accuracy of tympanic temperature readings in children under 6 years of age. *Pediatric nusrsing* 1999;25(1):39-42.
74. Alastair D Hay TJP, Andrew Wilson, Tom Fahey. The use of infrared thermometry for the detection of fever. *British Journal of General Practice* 2004;54(503):448–50.
75. Muma BK, Treloar DJ, Wurmlinger K, Peterson E, Vitae A. Comparison of rectal, axillary, and tympanic membrane temperatures in infants and young children. *Annals of Emergency Medicine* 1991;20(1):41-44.
76. Nwanyanwu OC, Ziba C, Redd SC, Luby SP. Palpation as a method of fever determination in Malawian children who are less than 5 years old: how reliable is it ? *Annals of Tropical Medicine and Parasitology* 1997;91(4):359-64.
77. Bergeson PS, Steinfeld HJ. How Dependable Is Palpation as a Screening Method for Fever? *Clinical Pediatrics* 1974;13(4):350-51.
78. Ernst TN, Philip M. Temperature Assessment by Parental Palpation. *Am J Dis Child* 1985;139(6):546-.
79. Graneto JW, Soglin DF. Maternal screening of childhood fever by palpation. *Pediatric emergency care* 1996;12(3):183-4.
80. Alves JG, Correia JB. Ability of mothers to assess the presence of fever in their children without using a thermometer. *Tropical doctor* 2002;32(3):145-6.
81. Banco L, Veltri D. Ability of Mothers to Subjectively Assess the Presence of Fever in Their Children. *Am J Dis Child* 1984;138(10):976-78.
82. Teng C. L. , H. Nik-Sherina, A. H. Zailinawati, and S. F. The Accuracy of Mother's Touch to Detect Fever in Children: A Systematic Review. . *The Oxford University Press.* 2007.
83. Robinson J, Jou H, Spady D. Accuracy of parents in measuring body temperature with a tympanic thermometer. *BMC Family Practice* 2005;6(1):3.
84. Whybrew K, Murray M, Morley C. Diagnosing fever by touch: observational study. *BMJ* 1998;317(7154):321-30.
85. Hooker EA, Smith SW, Miles T, King L. Subjective Assessment of Fever by Parents: Comparison With Measurement by Noncontact Tympanic Thermometer and Calibrated Rectal Glass Mercury Thermometer. *Annals of Emergency Medicine* 1996;28(3):313-17.
86. RD Wammanda SO. Ability of mothers to assess the presence of fever in their children: Implication for the treatment of fever under the IMCI guidelines. *Annals of African Medicine* 2009.
87. Singhi S, Sood V. Reliability of subjective assessment of fever by mothers. *Indian pediatrics* 1990;27(8):811-5.
88. Kumar R, Aggarwal A. Accuracy of maternal perception of neonatal temperature. 1996.
89. Dunyo SK, Koram KA, Nkrumah FK. Fever in Africa and WHO recommendation. *The Lancet* 1997;350(9090):1550.
90. Sakai R, Okumura A, Marui E, Niijima S, Shimizu T. Does fever phobia cross borders? The case of Japan. *Pediatrics International* 2011:no-no.
91. Banco L, Jayashekaramurthy S. The Ability of Mothers to Read a Thermometer. *Clinical Pediatrics* 1990;29(6):343-45.
92. Schmitt BD. Fever phobia. Misconceptions of parents about fevers. *American Journal of Diseases of Children* 1980;134 (2):176-81.
93. Blumenthal I. What parents think of fever. *Fam Pract* 1998;15(6):513-8.
94. Crocetti MT, Serwint JR. Fever: separating fact from fiction. *Contemporary Pediatrics* 2005;22(1):34-42.

95. Crocetti M, Moghbeli N, Serwint J. Fever phobia revisited: Have parental misconceptions about fever changed in 20 years? *Pediatrics* 2001;107 (6):1241-46.
96. Crocetti M, Sabath B, Cranmer L, Gubser S, Dooley D. Knowledge and management of fever among Latino parents. *Clin Pediatr (Phila)* 2009;48(2):183-9.
97. Betz MG, Grunfeld AF. 'Fever phobia' in the emergency department: a survey of children's caregivers. *Eur J Emerg Med* 2006;13(3):129-33.
98. Collazo M. Management of fever in children: study and practice in a center for family medicine. [Spanish]. *Boletin de la Asociacion Medica de Puerto Rico* 1992;84 (11):294-97.
99. Matziou V, Brokalaki H, Kyritsi H, Perdikaris P, Gymnopoulou E, Merkouris A. What Greek mothers know about evaluation and treatment of fever in children: an interview study. *Int J Nurs Stud* 2008;45(6):829-36.
100. Kilmon CA. Parents' knowledge and practices related to fever management. *J Pediatr Health Care* 1987;1(4):173-9.
101. Ames J, Hayden GF, Campbell RE, Lohr JA. Parents' conception of their use of over-the-counter medicines. *Clinical Pediatrics* 1982;21(5):298-301.
102. Walsh A, Edwards H, Fraser J. Over-the-counter medication use for childhood fever: a cross-sectional study of Australian parents. *J Paediatr Child Health* 2007;43(9):601-6.
103. Li SF, Lacher B, Crain EF. Acetaminophen and ibuprofen dosing by parents. *Pediatric emergency care* 2000;16(6):394-97.
104. Stagnara J, Vermont J, Durr F, Ferradji K, Mege L, Duquesne A, et al. [Parents' attitudes towards childhood fever. A cross-sectional survey in the Lyon metropolitan area (202 cases)]. *Presse Med* 2005;34(16 Pt 1):1129-36.
105. Kai J. What worries parents when their preschool children are acutely ill, and why: a qualitative study. *BMJ* 1996;313(7063):983-6.
106. Purssell E. Parental fever phobia and its evolutionary correlates. *Journal of Clinical Nursing* 2009;18 (2):210-18.
107. Rendon-Macias ME, Tellez-Leon G, Reyes-Valencia G, Apresa-Garcia T. Fever phobia: As a cause of overtreatment in children. [Spanish]. *Boletin Medico del Hospital Infantil de Mexico* 1996;53 (8):374-84.
108. Al-Eissa YA, Al-Sanie AM, Al-Alola SA, Al-Shaalan MA, Ghazal SS, Al-Harbi AH, et al. Parental perceptions of fever in children. *Ann Saudi Med* 2000;20(3-4):202-5.
109. Karwowska A, Nijssen-Jordan C, Johnson D, Davies HD. Parental and health care provider understanding of childhood fever: a Canadian perspective. *CJEM* 2002;4(6):394-400.
110. Kim D, Lee Y, Lee J, Jeong J, Kim J, Choi M. Perceptions and practices of fever: Survey for parents with febrile child visiting pediatric emergency department. *Annals of Emergency Medicine* 2009;Conference: American College of Emergency Physicians, ACEP 2009 Research Forum Boston, MA United States. Conference Start: 20091005 Conference End: 20091006. Conference Publication: (var.pagings). 54 (3 SUPPL. 1):S92.
111. Sedgwick P. Questionnaire surveys: sources of bias. *BMJ* 2013;347(aug30 1):f5265-f65.
112. Power R. Checklists for improving rigour in qualitative research. Never mind the tail (checklist), check out the dog (research). *Bmj.* 2001;323(7311):514-5.
113. Padian NS, McCoy SI, Balkus JE, Wasserheit JN. Weighing the gold in the gold standard: challenges in HIV prevention research. *Aids* 2010;24(5):621-35.
114. JeremyDale, RobertCrouch, DavidLloyd. Primary care: nurse-led telephone triage and advice out-of-hours. *Nursing Standard* 1998;12(47):39-43.
115. Boivin JM, Weber F, Fay R, Monin P. Management of paediatric fever: is parents' skill appropriate?. [French]. *Archives de pediatrie : organe officiel de la Societe francaise de pediatrie* 2007;14 (4):322-29.
116. Porter RS, Wenger FG. Diagnosis and treatment of pediatric fever by caretakers. *Journal of Emergency Medicine* 2000;19 (1):1-4.

Chapter 3 Parental knowledge and understanding of temperature measurement and fever: A systematic review

3.1 Febrile illness is a common and recurrent source of parental concern

As reported in Chapter 2, fever in children is one of the most common reasons for parents to seek medical attention. This chapter also showed that parents have unrealistic fears of harm from fever.[1 2] Indeed, parental fear was termed "fever phobia" by Schmitt in 1980. Two decades later a survey[3] showed a persistent fear of fever amongst parents and similar beliefs have been found in many other countries, including Canada,[4] the UK,[5] Turkey,[6] Japan,[7] France,[8] Kuwait[9] and Saudi Arabia.[10]

Fever is important for interactions with health care services, influencing the perceived need to attend clinics or seek medical help.

One of the main reasons for parents to use primary care, secondary care or emergency services is when they perceive their children to have feverish illness and to need urgent attention.[11] For example, fever has been reported as the main reason for 40% of parents of children aged less than 6 months, as well as 60% of children aged 6 months to 5 years, to attend GP practices.[11]

Parental fear of fever may lead to an excessive utilisation of health services,[12] in many cases parents use health care resources unnecessarily because they overestimate the dangers which leads to unnecessary clinic visits and inappropriate telephone calls. Inappropriate use of health-care services can also become a burden on paediatric emergency care.[13] Fever is an important factor in parental decisions to make appointments in health care; parent's main sources of information about fever are GPs and nurses.[6 9] Conversely, parents of children who actually have a fever but who are perceived to be well, may not seek medical attention despite the children having a serious medical conditions[14 15] (false negatives). In well children

that do not have a fever parents may seek medical attention or administer medication inappropriately and thereby use health services resources unnecessarily (false positives).

Inaccurate temperature measurement may lead to erroneous perceptions of illness severity, which can cause unnecessary consultations and need for urgent appointments, potentially preventing more serious cases being seen. The ability of parents to perform simple temperature measurements and interpret the results correctly is therefore a necessary skill to prevent serious disease, and unnecessary use of primary health care resources. Furthermore, it has been suggested by a study in 2000 that about two thirds of carers could not appropriately measure temperature, read thermometers and treat fever.[16] However, this study suggested that almost two thirds of carers were able to describe appropriate treatment.

3.2 What is known currently about how well parents can measure and interpret temperature

Chapter 2 highlighted that parents are pivotal in the initial detection of fever and the subsequent management decisions for children. Evidence suggests the diagnostic value of fever relates to the temperature height,[17] and duration of raised temperature,[18] combined with other signs, to predict those who need urgent medical attention. Temperatures of over 40 °C have an increased predictive value for serious bacterial infections. However, the evidence about the duration of raised temperature is not as robust, and is often associated with in difficulties in interpretation.[17]

Parental ability to read a thermometer has been shown to be poor.[19 1-3 20 21] A study conducted in 1998 found that almost half the parents used a liquid crystal forehead thermometer;[1] most could not use a glass thermometer and about a third treated their children with a temperature below 38 °C. Research has also highlighted poor mothers' performance at reading

thermometers by zone, by colours or by numbers; only 1 in 10 could accurately read different thermometers presented to them.[19] Parents predominantly used forehead strips at home, contrasting with their lack of hospital use due to their inaccuracy.[1] In addition, it has been shown that half of the parents did not know how long to leave the measurement device in situ before reading.[1] Furthermore, a substantial number of parents interpret temperature of less than 38 °C as relevant to fever.[3 9 21-24] A survey of relatively well-educated parents[25] showed between 21% and 32% were treating their children with antipyretics even when their temperature was within a normal range.

There is evidence that parents' definitions of fever thresholds are highly variable across different backgrounds and education levels. When caregivers in a 2001 survey were asked what is the lowest temperature which causes harms such as seizure or brain damage, 76% reported 40 °C.[3] Whereas two decades before a substantially lower number of parents (52%) reported similar beliefs.[2] Studies show that parental understanding of what constitutes a high fever has normally been defined as either 39 °C or 40 °C.[2-4 26] Some earlier studies[2 12] reported that parents thought untreated fevers could go as high as 41.7 °C.

3.3 Main gaps and aims of the study

Parents are often overly worried when their child has a fever.[3] These beliefs may create an unnecessary burden on the health system due to needless attendances, or in cases where high fever is misinterpreted this may be harmful for the overall health of the child. However, to date these issues have not been systematically examined in the literature.

The main gaps in knowledge include:

1) A systematic understanding of parental knowledge of temperature measurements

2) Understanding of parental knowledge of fever

3) A systematic understanding of parental beliefs about fever and parental care of fever

To understand these issues a systematic review was undertaken.

3.4 Aim of the study

The aim of this study is to systematically review the current literature on parental knowledge of different methods of measuring temperature and knowledge regarding interpretation of temperature measurements.

The main objectives of this systematic review are:

1) To gauge parental knowledge of temperature measurements

2) To gauge parental knowledge of fever

3) To gauge parental beliefs about fever and parental care of fever

3.5 Method

3.5.1 Search strategy and inclusion criteria

In December 2011 the author searched the following databases: Pubmed (1974 - Dec 2011), Embase (1974 - Dec 2011) and Psyinfo, Ovid (1974 - Dec 2011) and Cinahl, Ebsco (1981 - Dec 2011) using a search strategy which included a combination of subject heading and free texts incorporating the terms “parents”, “carers”, “thermometer”, “measurement”, “knowledge”, “skills”, “behaviour” (see full list in the Appendix 3.1 search). Articles were searched from the reference lists of included articles and were not limited by language of publication. In September 2012, an update of the search was further performed in Pubmed

(Dec 2011 - Sept 2012), Embase (Dec 2011 - Sept 2012) and Psyinfo, Ovid (Dec 2011 - Sept 2012) and Cinahl, Ebsco (Dec 2011 - Sept 2012).

Eligible studies included observational studies, involving either qualitative and quantitative design which described one or more parent's or caregiver's (including father, mother, caregiver or school/nursery staff) knowledge of different methods of measuring temperature, skills in measuring temperature, and knowledge regarding interpretation of temperature measurements in their children of ages birth to 18 years.

Studies were excluded if the children had a pre-existing disease or diagnosis of specific infectious diseases (e.g. yellow fever, malaria, dengue fever, Mediterranean fever or other tropical related fevers). Studies on urinary tract infections or skin infections were also excluded. Studies were included if the child had viral infections such as influenza, respiratory tract infections or fever for unknown causes. There was no limitation by country, setting of study or language.

The author screened titles and/or abstracts of all articles identified to exclude clearly irrelevant studies. Subsequently, two reviewers (JH, AM) screened the titles and/or abstracts for inclusion (see Appendix 3.2). Where there was disagreement the full text was reviewed for relevance by one reviewer (JH). Any discrepancies were resolved by consensus.

3.5.2 Quality assessment

The author independently assessed the quality of all included papers based on a quality assessment tool for quantitative studies, which was adapted for the quality assessment of the studies.[27] This was done by reducing the complexity of the existing fields, and confining it to fields applicable to these studies. For example, study design (all studies were survey questionnaires and interviews), confounders (all the studies had them i.e. ethnicity, sex, age) and blinding (both researchers and participants were informed about the collection tools)

were considered not to be applicable. This has left the four principle threats to validity of study findings as follows: selection bias, study size (small study size, little power), questionnaire completion rate (conventionally termed as attrition bias) and whether piloting of the questionnaire was undertaken. The first three fields were scored as high, medium or low and the fourth field was reported as yes or no (see Appendix 3.3). Global scores were not calculated, since arbitrary weighting of fields was judged inappropriate. It was judged more appropriate for these studies that each of the four threats to validity should be considered individually. This assessment was recommended by an expert in health technology assessment and senior systematic reviewer (MC) and by a clinical academic (CH) after advice was sought.

a) Selection bias was looked at in order to understand whether individuals selected in the study were likely to be representative of the target population, using the information provided in the published study. Also, whether the studies used random selection or not was taken into account. Studies randomised and representative of the population would be considered to have a low risk of bias. Studies non-randomised but from a representative sample of the population would be considered to have a moderate risk of bias. Finally, studies neither randomised nor from a representative sample of the population would be considered to have a high risk of bias. Studies that did not provide enough information to assess this item have been coded IR for incomplete reporting.
b) Smaller study size is associated with greater uncertainty in quantitative findings (and also would tend to render a study more susceptible to selection bias). As a guide to assess the risk of this bias the author used the power calculation for study size of the questionnaire study described in Chapter 6. Studies with over 300 participants were be given a low risk of bias, studies with 300 to 100 participants would be given a

moderate risk of bias and studies with under 100 participants a high risk of bias. All studies provided the number of participants.

c) Completion rate (an adaptation from attrition bias) was judged as low risk of bias, whether study completion rate was between 100 to 80%, moderate risk of bias if between 80 to 60%, and high risk of bias if completion rate within the study was lower than 60%. Studies that did not provide enough information to assess this item have been coded IR for incomplete reporting.

d) If the study questionnaire was reported to have been piloted the study was coded yes, if piloting was not done or was not mentioned then coding was no.

The quality assessment for the qualitative studies looked at following intrinsic component ratings of the studies:[28]

a) Was the research design appropriate to address the aims of the research

b) Was the recruitment strategy appropriate to the aims of the research

c) Was the data collected in a way that addressed the research issue

d) Has the relationship between the researcher and participants been adequately considered

e) Have ethical issues been taken into consideration

f) Was the data analysis sufficiently rigorous

g) Is there a clear statement of findings

As with the quality assessment of the quantitative studies all these sections were rated individually as having a low, moderate or high risk of bias. Where studies did not provide enough information to assess a specific item they were coded IR. If studies did address all the

above intrinsic component ratings they were allocated a low risk of bias. Studies that did not address up to two intrinsic component ratings were allocated a moderate risk of bias, in the case that more than two intrinsic component ratings were not addressed studies were allocated a high risk of bias.

3.5.3 Data extraction and synthesis

The author extracted the following relevant characteristics of included studies: details of respondents (number, gender, socio-economic and education levels), setting of the study (country, health care or other setting) and the year.

Findings related to methods and frequency of temperature measurement, interpretation and skills, methods used to treat fever (including use of antipyretics, sponging or other methods to lower temperature), fever threshold definition and perceptions and beliefs regarding fever were extracted. To ensure accuracy, all data was extracted by the author and checked by a second researcher (PG).

3.5.4 Statistical methods

Microsoft Excel 2007 and PAWS Statistic Data Editor 18 were used to analyse the main outcomes in the selected studies: 1) gender, 2) education, 3) socio-economic status, 4) thermometer ownership, 5) knowledge of how to use a thermometer, 6) use of antipyretics, sponging or other methods to manage fever, 7) understanding fever at different temperature thresholds (≤ 37 °C, 37 to 37.9 °C, 38 to 38.9 °C or ≥ 39 °C), 8) beliefs of fever effects (harmful, very harmful, seizures, brain damage, death and no concern) and 9) study location.

Data in this study was not normally distributed, therefore Wilcoxon signed-rank non-parametric tests were used to compare relationships between different temperature thresholds (≤ 37 °C, 37 to 37.9 °C, 38 to 38.9 °C or ≥ 39 °C) with parental management (antipyretics,

sponging or other methods) and beliefs of fever (harmful, very harmful, seizures, brain damage, death and no concern). This test was also used to understand if there was a difference in the amount of sponging used by parents as a fever management between questionnaire and interview studies.

Descriptive statistics were used to summarise the main characteristics from the data collected from the sample size of all studies. Information regarding beliefs and attitudes of fever were synthesised as a narrative summary.

3.5.5 Heterogeneity in the reviewed studies

All studies reviewed were observational, involving a quantitative or qualitative design. Studies did not explore the same questions[2 29] or used their own adaptations of previous questionnaires.[3 7] Socio-demographic questions collected were not homogeneous within the reviewed studies. Studies were performed in countries with different gross national income per capita, which may have had an impact on the techniques used to identity temperature or methods to treat fever[30] and their findings. Reviewed research was, therefore, performed on different ethnic groups in different countries,[31 32] as well as within countries.[33]

Furthermore, studies did not always use the same settings (hospital, clinics, medical centres, Kindergarten, household). All the above differences considerably increased the heterogeneity. After statistical advice from members of the statistics team (KT, BS), the use of descriptive statistics, confidence interval (using confidence interval analysis for Windows, CIA, software 2.2) and ranges was used for the analysis.

However, considerations were given to meta-analytical techniques such as fixed effects or random effects modelling. For this purpose Open Meta-Analyst software version 4.16.12 (Tufts University, 2007) was used.

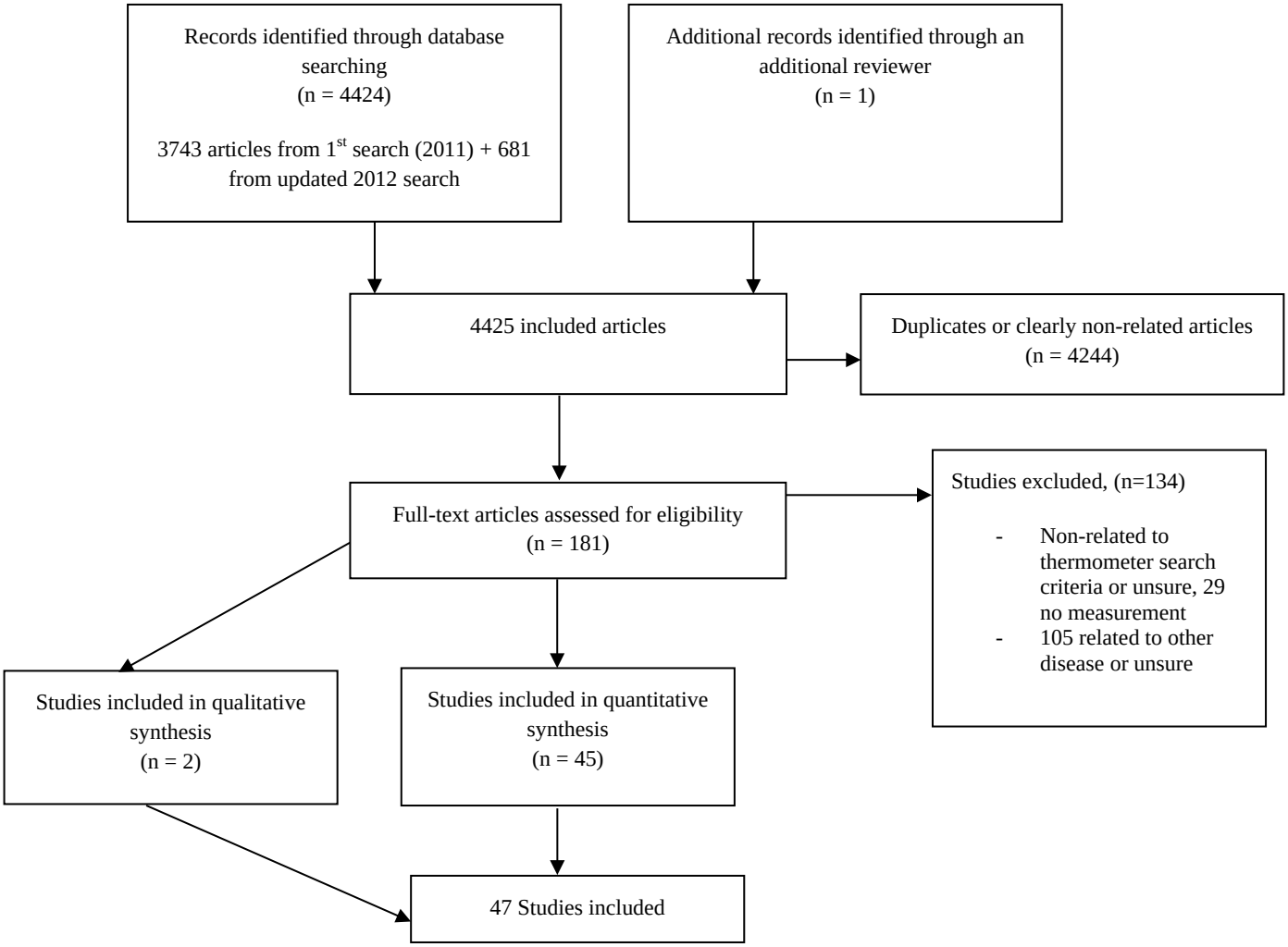
Initially both meta-analytical techniques were used to explore heterogeneity in socio-demographic variables such as education and fever management techniques such as sponging (see Appendix 3.4), revealing very high levels of heterogeneity. Due to the high levels of heterogeneity random effects modelling were considered to further explore other outcomes. Furthermore, proportions of caregivers that owned a thermometer, caregivers that knew how to use a thermometer, or their understanding of different temperature thresholds they considered a fever (≤ 37 °C, 37 to 37.9 °C, 38 to 38.9 °C or ≥ 39 °C) were investigated.

Proportions of carers that had a thermometer, those who knew how to use them, or their understanding of different temperature thresholds were extremely heterogeneous. This was seen in the form of $I^2 < 99\%$ (estimate of heterogeneity that is not due to chance) or very high levels of statistical heterogeneity ($p < 0.001$). An improvement in the estimates of precision was found with the use of meta-analytical techniques; however, the pooled estimates using random effects modelling were very similar to the medians initially obtained in any of the outcomes explored. Therefore, the use of meta-analytical techniques (see Appendix 3.4) did not offer a clear advantage over the ranges that were initially produced. This was shown, as an example, in the amount of sponging observed in caregivers when comparing the media obtained from the study results (46%), and the pooled estimates using random effects modelling technique from the same studies (45.7%). All other medias obtained (caregivers that own thermometers, caregiver appropriate thermometer use and their understanding of fever as different temperature thresholds) varied from its comparison with pooled estimates from the same studies in about 4%.

3.6 Results

4,425 studies were identified, of which 4,244 were excluded on the basis of title and abstract screening. Following full text review of the remaining 181 articles, 47 articles were included describing their results (see Flow Chart Search 3.1).

Figure 3.1 – Flow Chart Search the showing selection of included studies



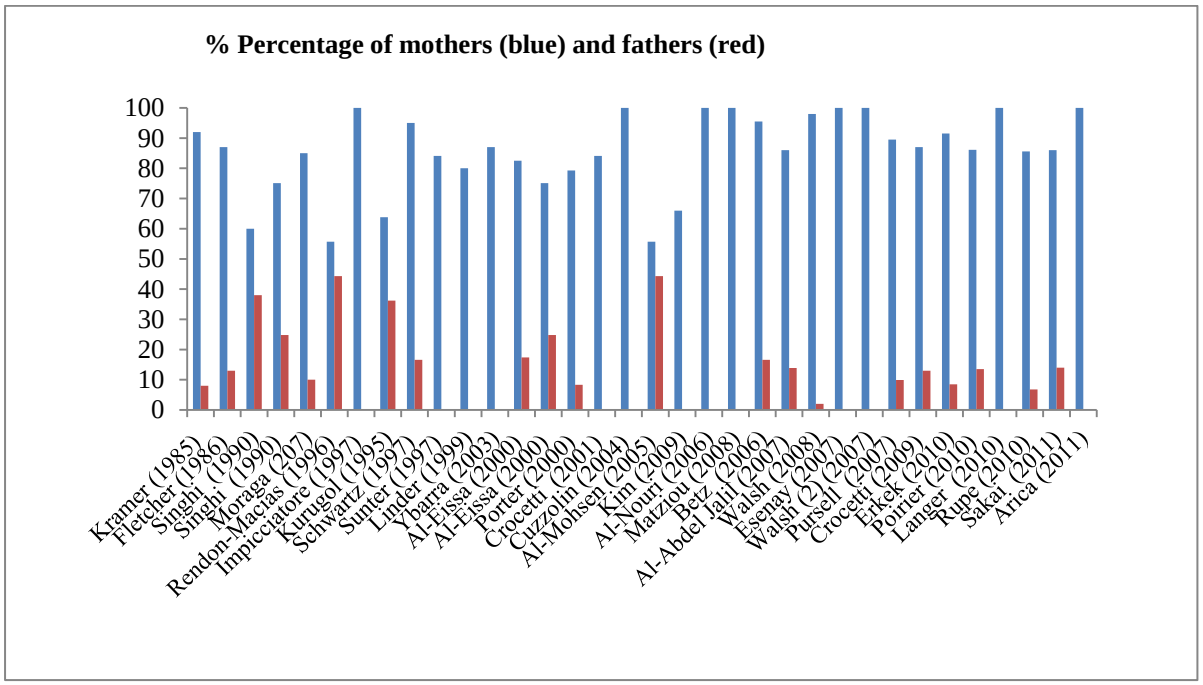
3.6.1 Study characteristics

The 47 selected studies included 20,427 participants from 22 different countries, including 16 from the Middle East, 11 from North America, nine from Europe (two from the UK), four from Asia, three from Latin America, two from Canada and two from Australia. Of the included studies 47% (22) were located in hospitals,[3-5 10 21 24 30 32-45] 26% (12) in clinics,[2 6 7 9 12 25 31 46-49] 19% (9) in medical centres,[22 23 42 48 50-53] and 17% (8) of the studies were performed in other locations[8 52 54-59] (schools, households, via postal survey or telephone interviewing).

There was considerable variation between studies in terms of number of participants and variables reported, almost a third of study participants were from one country (Turkey) (5,651, 28%), other countries included USA (12%, 2,517), Italy (8%, 1,656), Israel (8%, 1,650), France (6%, 1,240), and Saudi Arabia (5%, 1,077).

There were 35 questionnaires,[1-9 21-24 31 33-35 37-41 43 44 46-54 56 58 60] ten interviews (where the interviewer asked the survey questions)[12 25 30 32 35 36 42 53 55 57] and two qualitative studies.[45 59] Only 34 (72%) studies reported on gender. The majority of participants from these 34 studies (72%, 14,719) were mothers, and almost one third (26%) included only mother respondents (see Figure 3.2).

Figure 3.2 – Percentage of mothers and fathers



Education level of respondents was reported in 26 (55%) of the studies.[5 6 9 10 16 21-26 30 31 33 35-37 39 40 49 52-56 58 59] This showed that 23% of respondents had low education levels (defined as basic schooling level), 41% medium (defined as high school level) and 26% had high

education levels (defined as degree level and above). All studies included one or more of the inclusion criteria variables (understanding, knowledge, skills and interpretation of temperature measurements. Table 3.1 presents the study characteristic including the study type, number of participants and education level.

Table 3.1 – Study characteristics

Author	Country *	Setting	Study type	Number of participants (total)	Education level Low ed.*3	Med. ed.*3	High ed.*3
Abdullah et al., (1987)	Saudi Arabia (1)	Pediatric department (College of Medicine)	Questionnaire administered in "on call" days during the study looking at understanding and management of fever	36 (NR gender)	--	--	--
Al-Abdel Jalil, et al., (2007)	Kuwait (1)	4 Primary health care polyclinics which were clinics only open during the weekends	Cross-sectional questionnaire survey over 6 months asking mothers about their knowledge concerning fever in children, how they manage it at home or what their fears of fever are.	520 (100% mothers)	79	234(*² 65)	198(*² 455)
Al-Eissa et al., (2000)	Saudi Arabia (1)	Hospital based emergency department or walk -in clinics in four hospital	Questionnaire using a standard questionnaire to obtain background socio-demographic information and current knowledge of fever	481 (83% mothers, 17% fathers)	260	134	82
Al-Eissa (2000)	Saudi Arabia (1)	1 University hospital and 2 children's hospital. Parents recruited from waiting areas	Parents interviewed while waiting for appointments to understand parent's current knowledge and management of fever in their children	560 (75% mothers, 25% fathers)	--	201	313
Al-Mohsen (2005)	Kingdom of Bahrain (1)	Outpatient department in a private Pediatric Clinic. Two paediatric clinics at two hospitals	Survey from February until June 2004 opportunistic survey	312 (56% mothers, 44% fathers)	--	--	--
Al-Nouri (2006)	Iraq (3)	Children hospital	Interview designed to be easily answered by Iraqi mothers of various educational levels.	100 (100% mothers)	13	--	7

Author	Country *	Setting	Study type	Number of participants (total)	Education level Low ed.*3	Med. ed.*3	High ed.*3
Andersen (1988)	USA (1)	Metropolitan area, houses identified if there was a presence of toys, bikes etc…	Survey in parents' home hand delivered in a metropolitan area if children seemed to live there	100 (NR gender)	12	25	47
Arica (2011)	Turkey	Pediatric health and disease polyclinic and primary care polyclinic over a period of 24 months	Questionnaire using 32 open-ended questions	4500 (100% mothers)	724 (*²3 406)	3390 (*²1037)	386 (*²57)
Betz (2006)	United Arab Emirates (1)	Emergency department at a Medical centre	Questionnaire administered to a convenience sample, gathering demographic information, knowledge, definition and concern about fever	264 (95% mothers, 17% fathers)	55	124	82
Blumenthal (1998)	UK (1)	Local Pediatric hospital	Questionnaire survey administered for 6 months in 1997 about the parents' understanding of fever, methods of detecting it and its management	392 (NR gender)	--	--	--
Boivin (2007)	France (1)	29 Scholar institutions (divided in high, medium and low socio-economic status)	Questionnaire with socio-demographic questions and related to knowledge and skills of thermometry from parents	1038 (NR gender)	--	--	--
Collazo (1992)	Puerto Rico (1)	Family medicine centre	Convenient sample questionnaire, done over 3 weeks	149 (NR gender)	17	55	78
Crocetti et al., (2001)	USA (1)	2 urban hospital-based pediatric clinics	Questionnaire between June and September 1999, administered before either health maintenance or acute care visits	340 (84% mothers)	--	--	--
Crocetti et al., (2009)	USA (1)	Hospital based pediatric clinic	Questionnaire administered to a convenience sample between June 2004 and November 2004	180 (87% mothers, 13% fathers)	--	32	--
Cuzzolin et al., (2004)	Italy (1)	Family pediatrician hospital in rural urban Northern Italy	Questionnaire with socio-demographic info and knowledge or source of info to which temperatures to be considered fever	419 (100% mothers)	122	235	63
Erkek et al., (2010)	Turkey (2)	Pediatric Emergency Department at a research hospital	Interviewed between October and November 2007	200 (92% mothers, 8% fathers)	141	59	--
Esenay et al., (2007)	Turkey (2)	Pediatric Policlinic at hospital	Questionnaire with 17 open-ended and multiple choice questions	426 (100% mothers)	(*² 122)	(*² 230)	(*² 57)

Author	Country *	Setting	Study type	Number of participants (total)	Education level Low ed.*3	Med. ed.*3	High ed.*3
Fletcher (1986)	USA (1)	Family practice centre	Questionnaire administered over 6 months period in 1985	100 (87% mothers, 13% fathers)	--	--	--
Impicciatore, P. (1998) et al	Italy (1)	3 areas of Italy not specified where	Interview-survey conducted during February and March 1995	1237 (100% mothers)	458	591	198
Karwowska et al., (2002)	Canada (1)	Children hospital emergency department	Cross-sectional survey with 3 groups of parents and 4 groups of health care providers	510 (NR gender)	--	--	--
Kilmon (1987)	USA (1)	Clinic	Interview only English speaking, convenience sample from clinic waiting room, 10 minutes interview	100 (NR gender)	14 (*2 61)	78 (*2 32)	2 (*2 7)
Kim et al., (2009)	Korea (1)	Pediatric Emergency department	Convenient sample questionnaire	746 (66% of mothers)	--	--	--
Kramer et al., (1985)	Canada (1)	Private pediatric group practice	Interview in English or French, socio-demographic questions and questions about knowledge, attitudes and fears concerning fever and its treatment in young children	202 (92% mothers, 8% fathers)	--	--	--
Kurugol et al., (1995)	Turkey (2)	Pediatric Hospital	Questionnaire how to take the temperature and decrease the increased body temperature accurately and sources of parents knowledge were evaluated	174 (64% mothers, 36% fathers)	71	71	32
Langer (2010)	Germany (1)	2 pediatric hospital (outpatient department)	Qualitative study, 50 face to face interviews and 40 re-interviews by telephone	50 (100% mothers)	--	--	--
Linder et al., (1999)	Israel (1)	3 Community clinics, 1 medical centre, 1 baby clinic. Secular parents from a clinic. Ultra-orthodox parents from a community clinic. Pediatric emergency room, middle-class parents baby clinic	Cross-sectional retrospective survey carried out by distributing questionnaires	650 (80% mothers)	--	--	--
Matziou et al., (2008)	Greece (1)	Emergency department of a pediatric hospital	Questionnaire administered between December 2001 and March 2002	327 (100% mothers)	15	242	70

Author	Country *	Setting	Study type	Number of participants (total)	Education level Low ed.*3	Med. ed.*3	High ed.*3
Moraga et al., (2007)	Chile (2)	Private health centre	From February 2002 to February 2005 administered a questionnaire	235 (85% mothers, 10% fathers)	--	--	--
Pan (2003)	Singapore (1)	Local paediatric clinics at the National University Hospital	Cross-sectional questionnaire regarding the knowledge, attitude, fears and treatment given by parents	159 (NR gender)	(*219)	77(*255)	68(*220
Poirier, M. P. et al., (2010)	USA (1)	Pediatric Emergency Department	Convenient sample questionnaire regarding fever knowledge, behaviour and attitudes. Questions addressed the level of caregivers' concern regarding febrile children, caregivers' definition of fever and high fever, caregivers' opinions regarding consequences of high fever, preferred temperature-taking method and caregivers' treatment of fevers.	230 (86% mothers, 14% fathers)	101	112	17
Porter (2000)	USA (1)	Pediatric clinic emergency department (inner city hospital with homogeneous population)	Prospective survey recorded demographic information, including caretaker's relationship to the child, ages of caretaker and child, whether caretaker was a high school graduate or not, and whether a working thermometer (mercury or digital) was present in the household.	92 (79% mothers, 9% fathers)	--	25	--
Purssell (2009)	England	Paediatric Outpatient Department at a teaching Hospital	Questionnaire (based on Crocetti's questionnaire) of a convenience sample of 181 parents was recruited from attendees at a paediatric outpatients department of an inner hospital	181 (90% mothers, 10% fathers)	--	--	52
Rendon-Macias . et al., (1996)	Mexico (2)	Pediatric hospital	Prospective (and descriptive) survey with socio-demographic data, fever definition, detection mechanisms and temperature taken	771 (100% mothers)	--	--	--
Rupe et al., (2010)	USA (1)	Hospital-based pediatric clinic for the underserved	Between April and May 2008 questionnaire (survey) administered, parental definition of "fever" and "high fever," worry level when the child is	348 (86% mothers, 7% fathers)	--	226	--

			febrile, fever consequences, temperature-taking techniques, how fever is treated				
Author	**Country ***	**Setting**	**Study type**	**Number of participants (total)**	**Education level**		
					Low ed.*3	**Med. ed.*3**	**High ed.*3**
Sakai (2011)	Japan (1)	Pediatric outpatient clinic	Cross-sectional questionnaire presented to parents of children in the University hospital	211(85% mothers)	--	--	--
Sarrell et al., (2002)	Israel (1)	Pediatric community clinic	Cross sectional survey questionnaire of parents visiting the clinic for any reason during 1999 (except Winter months)	1000 (NR gender)	30	620	330
Saz . et al., (2009)	Turkey (2)	Emergency and ambulatory pediatrics department at University School of Medicine	Between January and July 2008, cross-sectional questionnaire administered asked about definition of fever, concerns about fever, and fever management.	200 (NR gender)	--	--	--
Schmitt (1980)	USA (1)	University-based walk-in clinic	Questionnaire on parents understanding of fever	81 (NR gender)	--	--	--
Schwartz et al., (1997)	USA (1)	Community based household survey	Community based household survey, cross-sectional survey open and closed-ended questions were included on their child's health, fever determination modalities, use of pediatric services, reproductive history, maternal health, acculturation level and socio-demographic characteristics	688 (100% mothers)	294	272 (*² 483)	122 (*² 184)
Singhi (1990)	India (3)	Paediatric Outpatient Service Hospital	Interview-questionnaire Interview to analyse parents understanding of fever, its harmful effects and treatment practices	100 (60% mothers, 38% fathers)	(*² 38)	(*² 34)	(*² 28)
Singhi (1990) 2	India (3)	Rural health centre	Interview to analyse parents understanding of fever, dangers and treatment practices	91 (100% mothers)	74 (*² 26)	17 (*² 59)	*² (5)

Author	Country *	Setting	Study type	Number of participants (total)	Education level Low ed.*3	Med. ed.*3	High ed.*3
Stagnara, et al., (2005)	France (1)	Telephone survey	Telephone survey interview at 202 households assessing the frequency and characteristics of healthcare utilisation and evaluate parents' knowledge and attitudes before consulting	202 (NR gender)	(*² 74)	(*² 69)	(*² 35)
Taveras et al., (2004)	USA (1)	Hospital clinic	Interview from July to October 1998 open-ended questions on socio-demographic data, parental beliefs and practices concerning fever, and children healthcare utilisation concerning fever	274 (NR gender)	--	--	--
Walsh et al., (2007) (2)	Australia (1)	Recruitment through letter appointments in 15 metropolitan areas	Qualitative study using semi-structured discussions with individuals and groups to explore fever management from parents of well-children	15 (100% mothers)		6	8
Walsh et al., (2008)	Australia (1)	Childcare centres, kindergartens, preschools	Community-based, postal survey was carried out in 2005 exploring parents' knowledge beliefs about fever, general fever management practices and sources of fever management information	401 (97% female, 3% male)	68	74	258
Ybarra Huesa et al., (2003)	Spain (1)	Health centres, streets, private houses, hospital, school, others	Questionnaire (survey-questionnaire) about socio-demographic factors and general knowledge about fever and its management	900 (87% mothers)	434	236	230

* (High Income (1), Upper Middle Income (2), Lower Middle Income (3)); ed.*3 stands for education (*²) Socio-economic status

3.6.2 Study Quality

All questionnaire and interview studies were prospective surveys with the exception of two qualitative studies, which can be seen detailed in Appendix 3.3. Quality of the included studies was based on: risk to validity of study findings from selection bias, small study size, poor completion rate and lack of piloting of the study questionnaire.

Overall, the study quality was variable in the selected studies (see Appendix 3.3). Based on these assessments, for selection bias, amongst the 45 studies 42 (93%) were rated as moderate rate to validity, 1 (2%) at low risk and 2 (4%) were rated as IR. For the study size, 4 (8%) were rated as high risk to validity, 20 (44%) at moderate risk and 21 (46%) at low risk. In terms of completion rate, most studies were rated as low risk bias 43 (95%), 1 was rated as having a moderate risk of bias (2%) and 1 (2%) as IR. Only one study (2%) mentioned the use of a pilot questionnaire before starting the study.

Both qualitative studies were rated as having a moderate risk of bias. These studies had clear statements of the aims of the research and adequate qualitative methodology, however, intrinsic component ratings of the studies such as adequate relationship between the researcher and the participant or possible ethical issues were not considered.

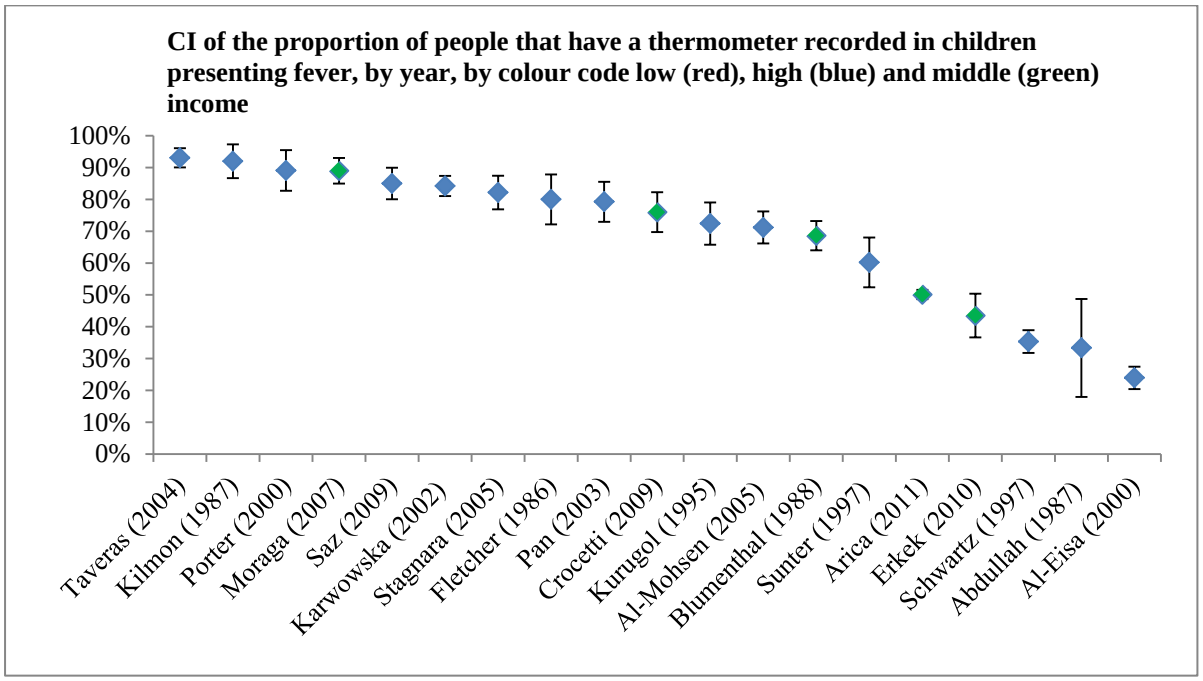
Eight studies[8 52 54-59] (16%) were questionnaires and interviews done in more than one location or random household surveys and not done purely by convenience sampling.

3.7 Understanding, skills and knowledge of temperature measurements from parents

3.7.1 Methods used to measure fever

Of the 47 studies, 19 (40%) reported data on the proportion of participants who owned a thermometer;[1 4 6 21 25 30 31 34 35 39 41 42 44 46 50 51 56 57 60] (see Figure 3.3), 14 of these studies were based on questionnaires and five were interviews. In all but four studies,[30 34 35 56] thermometer ownership was above 50%, from which all of these studies but one[56] were from non-Western countries such as Turkey and Saudi Arabia (the exception being a deprived Hispanic group from Mexico living in the USA).

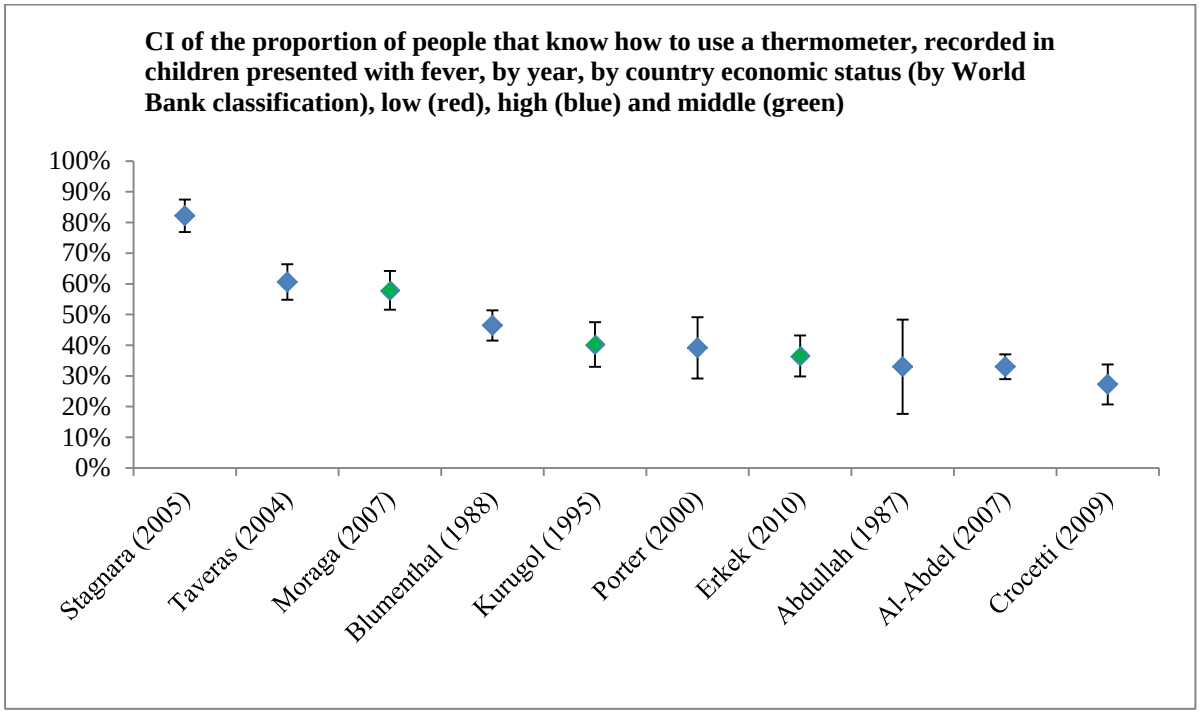
Figure 3.3 – Participants that own a thermometer



Fourteen studies mentioned other methods to measure fever, including the palpation method or looking at other signs.[6 8 9 23 25 30 31 33-36 45 46 56] Ten of these studies were from non-Western countries. The methods of assessment of the child's temperature were touching the child's forehead, arms, legs, chest, abdomen or back and looking at the body's appearance, child's behaviour, red cheeks and weakness.

Figure 3.4 shows ten studies which reported overall knowledge on how to correctly use a thermometer.[1 9 21 30 34 39 42 51 57 60] The knowledge ranged from 27% to 82% with a median of 40%. In one study (Taveras, 2004),[42] knowledge was far worse in Latin-Americans (11%) and African-Americans (7%) in comparison to Whites (93%).

Figure 3.4 – Participants that know how to use a thermometer



A Turkish study,[30] published in 2010, described the cheaper cost of mercury-in-glass thermometers was the reason for their predominant use. However, a 2011 study, in the same country,[6] showed a greater use of digital thermometers against mercury-in-glass thermometers (33% vs. 17%).

3.7.2 Treatment of fever

The author found that 32 (68%) studies reported participants' actions to treat fever to reduce a child's body temperature. These actions include: antipyretic medication, mostly paracetamol and ibuprofen, and in some cases a mixture of both. Other methods were also used, such as sponging, bathing, alcohol and ointments rubs, light dressing and cooling the room temperature.[1 2 6-10 12 21-26 30 33 35 36 42 43 45-47 53-55 58 59 61] Six studies from lower socioeconomic countries reported using other methods.[6 30 44 53-55] Five studies reported traditional remedies [21 31 34 42 53] such as camomile tea, boiled epazote leaves, warm water, water with alcohol, vinegar, romain lettuce olive oil massage, ice bags, vaporub, cold water, ice bath, or prayer.

Antipyretic medication was the most common treatment to reduce body temperature in children; with 32 studies reporting its use. [1-4 6-9 21-23 25 30 31 33 36 37 40-45 48 49 51-55 58 61 62] The range of use was 25% to 97% amongst participants in the studies, with a median of 85%. There seemed to be no difference between the study type or the year of publication.

Sponging was the second most used treatment to reduce body temperature in children; mentioned in 23 different studies,[1-4 6 7 9 21 23-25 30-32 35 36 43 45 46 55 58 61] ranging from 5% to 90%, with a median of 46%.

Table 3.2 shows a trend for questionnaire studies to report greater levels of sponging. The Wilcoxon signed-rank non-parametric test was used to compare the sample of interview and questionnaire studies from table 3.2, this test was used to understand if there was a difference between these study types. The test showed no statistical difference between the amount of sponging performed in questionnaires when compared with interviews ($p = 0.395$).

Table 3.2 – Studies with sponging percentages less or greater than 50% according to study type (questionnaire or interview)

	<50%	Study type		≥50%	Study type
Erkek et al., (2010)	5	interview	Kilmon (1987)	50	interview
Impicciatore et al., (1998)	11	interview	Al-Moshen (2005)	50	questionnaire
Walsh et al. (2008)	14	questionnaire	Pan (2003)	62	questionnaire
Karwowska et al. (2002)	19	questionnaire	Blumenthal (1998)	64	questionnaire
Schmitt (1980)	20	questionnaire	Matziou et al., (2008)	65	questionnaire
Collazo (1992)	23	questionnaire	Sakai	72	questionnaire
Al-Eissa et al., (2000)	26	Interview	Crocetti et al., (2009)	73	questionnaire
Rendon-Macias et al., (1996)	28	questionnaire	Crocetti et al., (2001)	73	questionnaire
Singhi (1990)	29	interview	Al-Abdel Jalil et al., (2007)	75	questionnaire
Pursell (2007)	34	questionnaire	Al-Nouri (2006)	82	interview
Arica et al., (2011)	42	questionnaire	Singhi (1990)	90	questionnaire

Other methods used to reduce body temperature in children were mentioned in 16 studies.[6 7 21-25 30 32 34 36 44 53 54 58 63]

The relationships between the parental use of antipyretic medications and different temperature thresholds, use of antipyretic medications and beliefs of harmful effects from fever were examined in table 3.3 using the Wilcoxon signed-rank non-parametric tests which identified a statistically significant relationship (p = 0.002) between providing antipyretic medication by parents and temperature thresholds of 37.1 to 37.9° C. This meant that parents reported to administer more antipyretic medication at these temperature levels when compared with other temperature thresholds. Furthermore, a significant relationship between parental feelings of harm caused by fever and reported used of antipyretic medication was also observed (p = 0.007). Parental thoughts of providing antipyretic medication seemed to increase when they thought a fever was defined as harmful to a child, therefore, there was an association between thoughts of fever being detrimental towards the child and providing antipyretics.

Table 3.3 – Wilcoxon signed-rank non-parametric tests

Management			**Significance**				**Significance**
Antipyretics	vs.	< 37° C	0.376	Antipyretics	vs.	Harmful	0.007
Antipyretics	vs.	37.1 to 37.9 °C	0.002	Antipyretics	vs.	Very harmful	0.313
Antipyretics	vs.	38 to 38.9 °C	0.126	< 37 °C	vs.	Harmful	0.87
Antipyretics	vs.	39 °C	0.376	37 to 37.9 °C	vs.	Harmful	0.377
Antipyretics	vs.	Sponging	0.485	38 to 38.9 °C	vs.	Harmful	0.347
Antipyretics	vs.	Other methods	0.109	39 °C	vs.	Harmful	0.074

3.7.3. Definition of fever from parents

Parental understanding of the child's body temperature considered to be a fever and/or high fever varied greatly. In 15 studies[1 6 8 9 23 30 35 41 43 44 46 47 53 58 61] parents considered a fever to be equal to or below 37 °C (median 12%, range 1% to 41%).

In 23 studies[1-3 7-9 12 21-24 30 31 34 35 38 40 43 47 50 53 58 62] some parents considered a fever to be between 37.1 °C and 37.9 °C, (median of 28%, range 5% to 80%). No differences were found by study type or year of publication, however there was a smaller number of countries from lower socioeconomic level with parents believing fever to be within these temperatures.[30 43 44 53]

In 17 studies[1 3 6-9 34 35 43 44 58 61 62] some parents considered a fever to be much higher, between 38 °C and 38.9 °C (median of 49%, range 1% to 84%). No differences were found between the study type and the country where the study was performed.

In 12 studies[3 6-8 21 35 40 43 50 58 61] some parents considered fever to be very high equal to or above 39 °C (median of 14%, range from 1% to 59%). Wilcoxon signed-rank non-parametric tests showed a trend for fever over 39 °C to be related to the beliefs of harm caused by fever ($p = 0.074$).

Figure 3.5 shows across 17 studies[1 3 6-9 34 35 43 44 58 61 62] that the proportion of parents able to interpret a fever correctly varied substantially from 20% to 70%. Even later studies in 2008 to 2013 demonstrated poor understanding by parents. Three of these studies had a higher than average number of correct interpretations: these were from Puerto Rico,[23] the UK[5] and France[8].

Figure 3.5 – Percentage of parents able to interpret a fever correctly in children

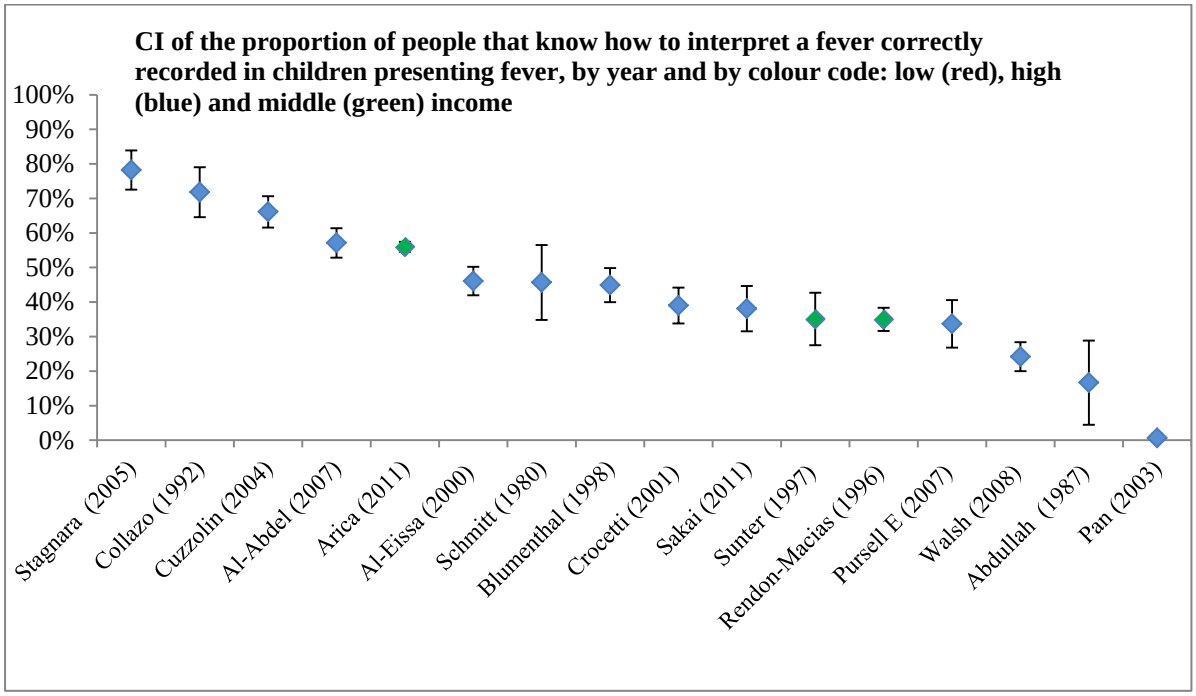


Figure 3.6 demonstrated that 12 studies defined fever as a temperature range as opposed to an actual value. Participants in these studies suggested fever was within a range of temperature and not represented by a single value.

Figure 3.6 – Studies that define fever as a temperature range

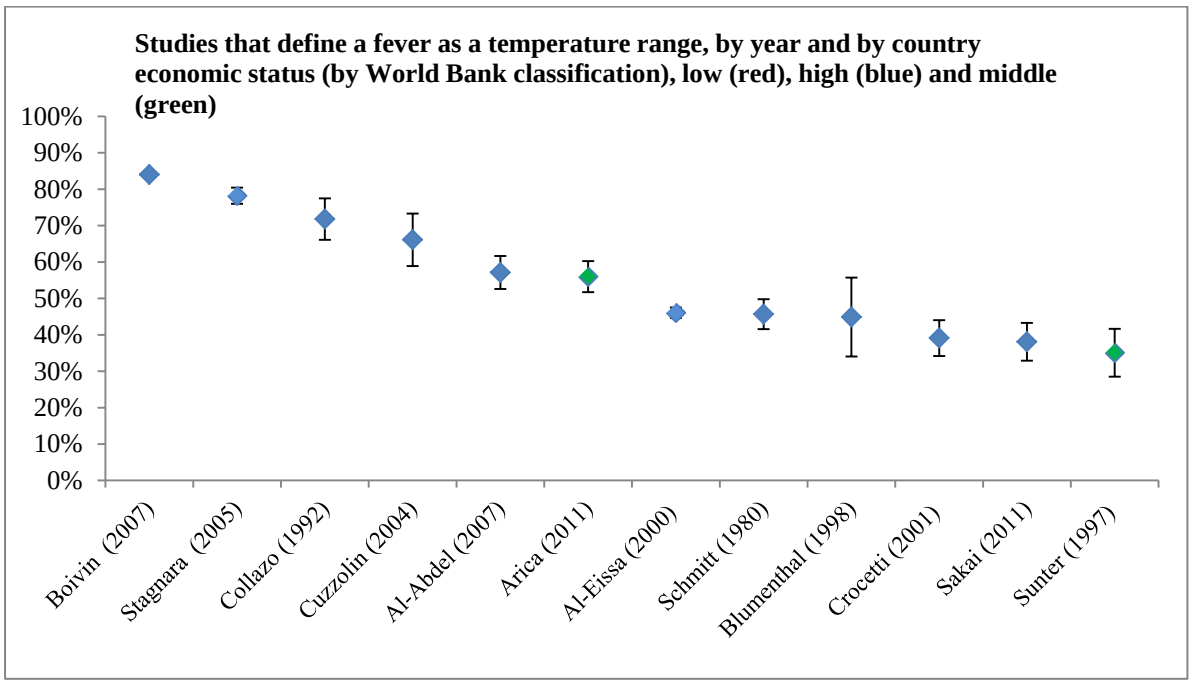


Table 3.4 illustrates the main characteristics of the reviewed studies, the number of studies where parents used antipyretic as well as non-recommended management of fever.

Table 3.4 – Studies by main characteristics

	No. of studies	No. of participants in the studies	Median/range
Participants owning a device to measure temperature	**19**	5,185	Median 76%, range 24% to 93%
Participants correctly using a device to measure temperature	**10**	1,062	Median 40%, range 27% to 82%
No. considered fever equal or below 37 °C	**13**	1,582	Median 12%, range 1% to 41%
Parents administering antipyretic medication	**32**	9,743	Median 85%, range 27% to 97%
Non-recommended methods to reduce temperature (sponging)	**23**	4,558	Median 46%, range 5% to 90%

3.7.4 Parents' perceptions

Parental beliefs and actions about fever

Two studies were qualitative and provided narrative information.[45 59] Parents associated the following changes in the child's normal behaviour among others: fever including lethargy, agitation or irritability.[64] Parents thought that fever may be harmful to their children, and this fear of fever, referred to as "Fever phobia" in Chapter 2, can have an effect on subsequent treatment decisions and can have psychological effects upon the parents.

Moreover, parents perceive there is a risk of brain damage and fits[34] and often wake their children to treat them.

Parents identified many different consequences of fever or untreated fever such as: dehydration, seizure, coma, brain damage, vomiting, death, diarrhoea, sleepiness, passing out, shock, paralysis, epilepsy, coma, stroke, eye damage, memory loss, mental retardation, infertility and other consequences. Consequences were grouped in order of importance in six mutually exclusive categories: harmful (not involving very serious consequences that could lead to permanent or serious damage in the child such as dehydration, headache, diarrhoea, sleepiness), very harmful (involving very serious consequences that could lead to permanent or serious damage in the child such as shock, paralysis, epilepsy, coma, stroke, eye damage, infertility), febrile seizures, brain damage, death, no concern. Parents did not always seem to have the knowledge or understanding of how to correctly administer antipyretic medication[9 25 35 43 51] and in some cases administered antipyretic medication to children before consulting a GP,[6 22 50] which may promote overmedicating or unnecessarily medicating children.

Mothers main sources of knowledge about fever in children mentioned across the studies were doctors and nurses, relatives and family,[6 51] friends, reading, internet, pharmacists,[6 9] health providers,[25] doctors,[6 9 38] and health personnel.[9 48]

3.8 Discussion

3.8.1 Main findings

The main findings of this chapter are that thermometer ownership amongst parents is patchy and reported use by parents is often incorrect. Furthermore, parental knowledge of fever and what temperatures constitute a fever is limited.

The amount of thermometers available on the market and information readily available in the internet about thermometers has increased rapidly over time.[65] However, this has not been matched by an improvement in knowledge, over this same time, as to how to use a thermometer correctly.

In addition, antipyretic medication was administered to children often at temperatures which did not constitute a fever, and occasionally, in inappropriate doses, and children were often woken at night to be administered antipyretics. Parents from countries with lower socio-economic level did not seem to administer as much antipyretic medication, however, they often used more traditional remedies to treat fever.

Finally, many parents have substantial beliefs about the fear of fever that may be affecting their behaviour, particularly with regard to subsequent decision making.

3.8.2 What it means

According to NICE[11] fever is “an elevation of the body temperature above the normal daily variation”. For normal children, body temperature is based on a range of temperatures at various sites: oral (33.2 - 38.2 °C), rectal (34.4 - 37.8 °C), tympanic (35.4 - 37.8 °C), axillary (35.6 - 37.2 °C) and forehead (35.6 - 37.9 °C)[66]. Moreover, the guideline[11] defines a temperature ≥ 38 °C or higher as the cut off for defining fever.

Parental thoughts of children becoming acutely ill[1] may trigger concerns, which may be one of the reasons why in lower socio-economic countries fever is often treated with traditional remedies. However, this could also be due to a lower availability of antipyretics and/or due to economic reasons such as the costs of appropriate management.

Parental use of healthcare resources due to feverish illness in children and its impact

Fever is very common among young children and a frequent reason for parents to contact primary care clinics/physicians.

Yet, there is a very low prevalence of serious illness and it can be difficult to identify unwell children solely on the existence of fever.[17] [67] Furthermore, the vast majority of cases of febrile illness in children are usually due to self-limiting viral infections without the need of a medical intervention.

Febrile illness in children can inappropriately consume healthcare resources. Yet, parents are in most cases making decisions about their children such as treating or taking the child for further care with little input and guidance. Parental knowledge and beliefs of fever and temperature measurements ultimately will influence patterns of healthcare use. Correct interpretation and instruction in temperature measurements and fever may help decrease unnecessary referrals and enhance fever management.

3.8.3 Implications for practice

Parents are, in most cases, the first step in detecting fever in children. A correct and skilled temperature measurement is therefore of vital importance to identify a child's vital signs and identify the cases where further medical attention is warranted.

Empowering and educating parents to own a working thermometer may therefore be of importance. Furthermore, teaching them how to correctly take a temperature measurement, and providing them with guided information on how to treat elevated temperature in children

could help to decrease unnecessary attendances in primary care, and, to increase better parental temperature management with their children.

3.8.4 Implications for further research

This review highlights parental lack of understanding, knowledge and skills of temperature measurements in children. However, the author did not find any study where all variables (demographic and clinical) were mentioned. The reporting of parental understanding, knowledge and skills of temperature measurements in children markedly differed. It would be beneficial if further studies provided a more integrated understanding of parental knowledge of temperature measurements in children using such appropriate variables. These studies should collect information on socio-demographic data (study type, number of participants, education and study location) and specific data related to management and beliefs of fever (reporting thermometer ownership and type, understanding of fever at different temperature thresholds and beliefs about fever).

A cheaper thermometer cost was one reason suggested for its predominant use. It would be useful to understand whether there may be a relation between thermometer cost and usage of certain types of thermometer, accuracy of readings, ease of use and subsequent impact on referral patterns.

More recent studies have shown that a greater proportion of parents use a digital thermometer in children[6]. It would also be of interest to understand whether those thermometers require less temperature measurement knowledge, which may enhance parental interpretation of fever in children.

Most of the data from studies were collected in hospitals[1 3 4 10 21 24 30 33-43 53 61 68] and clinics[2 6 9 25 31 46-49 60] compared to any other type of setting, by convenience sampling. Randomly collected data in more locations may provide different results. Many of the studies were old

when mercury-in-glass was more relevant and relatively few new studies have been undertaken. Further research in specific variables such as type of treatment, for example mixing different antipyretic medications, could be useful to highlight newer parental beliefs. In addition, there is a lack of current UK study knowledge in primary care, as stated, there is a need to better understand the situation today. If results find that lack of parental understanding still exists, it will then highlight a considerable room for improvement in parental knowledge in the UK.

3.8.5 Limitations

Studies differed in their structure greatly and the author has tried to summarise the variables in the studies to the best of his ability. Characteristics from studies were not always described in the same way (i.e. fever expressed as a single figure, a range or a continuous variable) and the author has tried to compile results from studies in a comprehensive manner.

Data in the studies was collected by convenience sampling, this may have promoted sampling bias meaning that results obtained may not be representative of the whole population.

Two studies were in Turkish but data was extracted from the abstract section and tables within the studies. Studies in any other languages were extracted by the author.

There were only two UK studies and actually very few up to date studies. In addition, such studies are always limited by recall bias and respondent bias which may have affected the findings.

3.8.6 Conclusions

Parents not owing a thermometer, not understanding the temperature that constitutes a fever, and/or not understanding how to correctly take a temperature measurement from a child may be factors that help to either over or underestimate fever episodes in children. Correctly

identifying fever is important in order to diminish the progression of infection, which is a major cause of morbidity and mortality in children 0 to 5 years of age. However, the current evidence is limited, as many studies are old and no studies have been conducted in a UK primary care setting which reflect current practice.

3.9 References

1. Blumenthal I. What parents think of fever. *Fam Pract* 1998;15(6):513-8.
2. Schmitt BD. Fever phobia. Misconceptions of parents about fevers. *American Journal of Diseases of Children* 1980;134 (2):176-81.
3. Crocetti M, Moghbeli N, Serwint J. Fever phobia revisited: Have parental misconceptions about fever changed in 20 years? *Pediatrics* 2001;107 (6):1241-46.
4. Karwowska A, Nijssen-Jordan C, Johnson D, Davies HD. Parental and health care provider understanding of childhood fever: a Canadian perspective. *CJEM* 2002;4(6):394-400.
5. Purssell E. Parental fever phobia and its evolutionary correlates. *Journal of Clinical Nursing* 2009;18 (2):210-18.
6. Gunher Arica S, Arica V, Onur H, Gülbayzar S, Dağ H, Obut Ö. Knowledge, attitude and response of mothers about fever in their children. *Emergency Medicine Journal* 2011.
7. Sakai R, Okumura A, Marui E, Niijima S, Shimizu T. Does fever phobia cross borders? The case of Japan. *Pediatrics International* 2011:no-no.
8. Boivin JM, Weber F, Fay R, Monin P. Management of paediatric fever: is parents' skill appropriate?. [French]. *Archives de pediatrie : organe officiel de la Societe francaise de pediatrie* 2007;14 (4):322-29.
9. Al-Abdel Jalil HK, Jumah NA, Al-Baghli AA. Mothers' knowledge, fears and self-management of fever: A cross-sectional study from the capital governorate in Kuwait. *Kuwait Medical Journal* 2007;39 (4):349-54.
10. Al-Eissa YA, Al-Sanie AM, Al-Alola SA, Al-Shaalan MA, Ghazal SS, Al-Harbi AH, et al. Parental perceptions of fever in children. *Ann Saudi Med* 2000;20(3-4):202-5.
11. NICE. Assessment and initial management of feverish illness in children younger than 5 year. *BMJ* 2007;334(7604): 1163–1164.
12. Kramer MS, Naimark L, Leduc DG. Parental fever phobia and its correlates. *Pediatrics* 1985;75(6):1110-3.
13. T. T. Background problems in pediatric emergency care. *Current situation an perspective on pediatric emergency care* 2004:17-19.
14. Thompson MJ, Ninis N, Perera R, Mayon-White R, Phillips C, Bailey L, et al. Clinical recognition of meningococcal disease in children and adolescents. *The Lancet*;367(9508):397-403.
15. Thompson M M-WR, Harden A, Perera R, McLeod Diane and Mant D. Using vital signs to assess children with acute infections: a survey of current practice. *British Journal of General Practice* 2008(58):236-41
16. Porter RS, Wenger FG. Diagnosis and treatment of pediatric fever by caretakers. *The Journal of Emergency Medicine* 2000;19(1):1-4.
17. Van den Bruel A, Haj-Hassan T, Thompson M, Buntinx F, Mant D. Diagnostic value of clinical features at presentation to identify serious infection in children in developed countries: a systematic review. *The Lancet*;375(9717):834-45.
18. Pratt A, Attia MW. Duration of fever and markers of serious bacterial infection inyoung febrile children. *Pediatrics International* 2007;49(1):31-35.
19. Banco L, Jayashekaramurthy S. The Ability of Mothers to Read a Thermometer. *Clinical Pediatrics* 1990;29(6):343-45.
20. Crocetti MT, Serwint JR. Fever: separating fact from fiction. *Contemporary Pediatrics* 2005;22(1):34-42.
21. Crocetti M, Sabath B, Cranmer L, Gubser S, Dooley D. Knowledge and management of fever among Latino parents. *Clin Pediatr (Phila)* 2009;48(2):183-9.
22. Betz MG, Grunfeld AF. 'Fever phobia' in the emergency department: a survey of children's caregivers. *Eur J Emerg Med* 2006;13(3):129-33.
23. Collazo M. Management of fever in children: study and practice in a center for family medicine. [Spanish]. *Boletin de la Asociacion Medica de Puerto Rico* 1992;84 (11):294-97.

24. Matziou V, Brokalaki H, Kyritsi H, Perdikaris P, Gymnopoulou E, Merkouris A. What Greek mothers know about evaluation and treatment of fever in children: an interview study. *Int J Nurs Stud* 2008;45(6):829-36.
25. Kilmon CA. Parents' knowledge and practices related to fever management. *J Pediatr Health Care* 1987;1(4):173-9.
26. Singhi S, Padmini P, Sood V. Urban parents' understanding of fever in children: its dangers, and treatment practices. *Indian Pediatr* 1991;28(5):501-5.
27. Tools NCfMa. Quality Assessment Tool for Quantitative Studies. In: Hamilton OMUUA, 2010), editor, 2008.
28. Network CI. Critical Appraisal of Qualitative Research, 2012.
29. Rupe A, Ahlers-Schmidt C, Wittler R. A comparison of perceptions of fever and fever phobia by ethnicity. *Clin Pediatr* 2010;49:172 - 76.
30. Erkek N, Senel S, Sahin M, Ozgur O, Karacan C. Parents' perspectives to childhood fever: comparison of culturally diverse populations. *J Paediatr Child Health* 2010;46(10):583-7.
31. Pan JSY, Shek LPC. Parental Knowledge, Practices and Fears Regarding Fever in Singapore Children - A Questionnaire Survey. *Singapore Paediatric Journal* 2003;45 (2):71-76.
32. Singhi S, Sood V. Reliability of subjective assessment of fever by mothers. *Indian pediatrics* 1990;27(8):811-5.
33. Rupe A, Ahlers-Schmidt CR, Wittler R. A comparison of perceptions of fever and fever phobia by ethnicity. *Clin Pediatr (Phila)* 2010;49(2):172-6.
34. Abdullah MA, Ashong EF, Al Habib SA, Karrar ZA, Al Jishi NM. Fever in children: diagnosis and management by nurses, medical students, doctors and parents. *Annals of tropical paediatrics* 1987;7 (3):194-99.
35. Al-Eissa YA, al-Zamil FA, al-Sanie AM, al-Salloum AA, al-Tuwaijri HM, al-Abdali NM, et al. Home management of fever in children: rational or ritual? *Int J Clin Pract* 2000;54(3):138-42.
36. Al-Nouri L, Basheer K. Mothers' perceptions of fever in children. *J Trop Pediatr* 2006;52(2):113-6; discussion 17.
37. Cuzzolin L, Zaffani S, Gangemi M, Elli P, Cremonese P, Chiamenti G, et al. Parental attitudes about the most common symptoms/pathologies in pre-school children. *Italian Journal of Pediatrics* 2004;30 (4):248-53.
38. Kim D, Lee Y, Lee J, Jeong J, Kim J, Choi M. Perceptions and practices of fever: Survey for parents with febrile child visiting pediatric emergency department. *Annals of Emergency Medicine* 2009;Conference: American College of Emergency Physicians, ACEP 2009 Research Forum Boston, MA United States. Conference Start: 20091005 Conference End: 20091006. Conference Publication: (var.pagings). 54 (3 SUPPL. 1):S92.
39. Kurugol NZ, Tutuncuoglu S, Tekgul H. The family attitudes towards febrile convulsions. *Indian J Pediatr* 1995;62(1):69-75.
40. Poirier MP, Collins EP, McGuire E. Fever phobia: a survey of caregivers of children seen in a pediatric emergency department. *Clin Pediatr (Phila)* 2010;49(6):530-4.
41. Saz EU, Koturoglu G, Duyu M, Ozananar Y, Kurugol Z, Sever M. Fears of fever and fever management in Turkish families. [Turkish]. *Cocuk Enfeksiyon Dergisi* 2009;3 (4):161-64.
42. Taveras EM, Durousseau S, Flores G. Parents' beliefs and practices regarding childhood fever: a study of a multiethnic and socioeconomically diverse sample of parents. *Pediatr Emerg Care* 2004;20(9):579-87.
43. Rendon-Macias ME, Tellez-Leon G, Reyes-Valencia G, Apresa-Garcia T. Fever phobia: As a cause of overtreatment in children. [Spanish]. *Boletin Medico del Hospital Infantil de Mexico* 1996;53 (8):374-84.
44. Sunter AT, Dundar C, Agac R, Uysal S, Gurses N. Knowledge and behaviors of mothers about fever. [Turkish]. *Ondokuz Mayis Universitesi Tip Dergisi* 1997;14 (2):106-11.
45. Langer T, Pfeifer M, Sonmez A, Tarhan B, Ostermann T. Appraisal of childhood fever by German and Turkish mothers in Germany-results of a pilot study. *Turkish Journal of Pediatrics* 2010;52 (5):471-80.
46. Al-Mohsen AHKE. Fever in children: Parental perceptions. *Journal of the Bahrain Medical Society* 2005;17 (2):100-06.

47. Esenay FI, Isler A, Kurugol Z, Conk Z, Koturoglu G. Mothers' approach to feverish child and fever phobia. [Turkish]. *Turk Pediatri Arsivi* 2007;42 (2):57-60.
48. Linder N, Sirota L, Snapir A, Eisen I, Davidovitch N, Kaplan G, et al. Parental knowledge of the treatment of fever in children. *Isr Med Assoc J* 1999;1(3):158-60.
49. Sarrell M, Cohen HA, Kahan E. Physicians', nurses', and parents' attitudes to and knowledge about fever in early childhood. *Patient Educ Couns* 2002;46(1):61-5.
50. Fletcher JL, Jr., Creten D. Perceptions of fever among adults in a family practice setting. *J Fam Pract* 1986;22(5):427-30.
51. Moraga MFJ, Horwitz ZB, Romero SC. Fever phobia: Parents' knowledge and attitude towards fever. [Spanish]. *Revista chilena de pediatria* 2007;78 (2):160-64.
52. Ybarra Huesa J, Elorza Arizmendi JFJ, Gonzalez Aracil J. Study of the knowledge and attitudes of the general population concerning the management of a child with fever. [Spanish]. *Acta Pediatrica Espanola* 2003;61 (5):239-46.
53. Singhi S, Singh S. Fever: maternal knowledge, attitude and treatment practices in a rural area. *Indian Pediatr* 1990;27(10):1103-6.
54. Andersen AR. Parental perception and management of school-age children's fevers. *The Nurse practitioner* 1988;13 (5):8-9, 12-18.
55. Impicciatore P, Nannini S, Pandolfini C, Bonati M. Mother's knowledge of, attitudes toward, and management of fever in preschool children in Italy. *Prev Med* 1998;27(2):268-73.
56. Schwartz N, Guendelman S, English P. Thermometer use among Mexican immigrant mothers in California. *Soc Sci Med* 1997;45(9):1315-23.
57. Stagnara J, Vermont J, Durr F, Ferradji K, Mege L, Duquesne A, et al. [Parents' attitudes towards childhood fever. A cross-sectional survey in the Lyon metropolitan area (202 cases)]. *Presse Med* 2005;34(16 Pt 1):1129-36.
58. Walsh A, Edwards H, Fraser J. Parents' childhood fever management: community survey and instrument development. *J Adv Nurs* 2008;63(4):376-88.
59. Walsh A, Edwards H, Fraser J. Influences on parents' fever management: beliefs, experiences and information sources. *J Clin Nurs* 2007;16(12):2331-40.
60. Porter RS, Wenger FG. Diagnosis and treatment of pediatric fever by caretakers. *Journal of Emergency Medicine* 2000;19 (1):1-4.
61. Purssell E. Treatment of fever and over-the-counter medicines. *Arch Dis Child* 2007;92(10):900-1.
62. Stagnara J, Vermont J, Durr F, Ferradji K, Mege L, Duquesne A, et al. Parents' attitudes towards childhood fever: A cross-sectional survey in the Lyon metropolitan area (202 cases). [French]. *Presse Medicale* 2005;34 (16 I):1129-36.
63. Boivin JM, Weber F, Fay R, Monin P. [Management of paediatric fever: is parents' skill appropriate?]. *Arch Pediatr* 2007;14(4):322-9.
64. Walsh A, Edwards H, Fraser J. Attitudes and subjective norms: determinants of parents' intentions to reduce childhood fever with medications. *Health Educ Res* 2009;24(3):531-45.
65. D Crawford Ng, S Wetworth. Thermometer review: UK market survey. 2005.
66. Crawford DC, Hicks B, Thompson MJ. Which thermometer? Factors influencing best choice for intermittent clinical temperature assessment. *Journal of Medical Engineering & Technology* 2006;30(4):199-211.
67. Van den Bruel A, Aertgeerts B, Bruyninckx R, Aerts M, Buntinx F. Signs and symptoms for diagnosis of serious infections in children: a prospective study in primary care. *British Journal of General Practice* 2007;57(540):538–46.
68. Langer T, Pfeifer M, Soenmez-Yekta A, Schnepp W. Influence of the cultural background on fever concepts of German and Turkish mothers with particular consideration of febrile seizures. *Epilepsia* 2010;Conference: 50th Meeting of the German Society Against Epilepsy Wiesbaden Germany. Conference Start: 20100428 Conference End: 20100501. Conference Publication: (var.pagings). 51:10-11.

Chapter 4 Understanding parental knowledge, beliefs and practices regarding measurement of temperature and management of fever in children under five years: A focus group interview

4.1 Introduction

Parental understanding and treatment of fever may include a combination of different factors, such as traditional beliefs and modern scientific knowledge.[1] It has been suggested that the modern scientific model, where knowledge prevails in the treatment and diagnosis of disease, is more acceptable with increasing education; shown by research into groups with different levels of schooling.[1] In this respect, a qualitative study which explored parental views and feelings of children with acute otitis media and the use of antibiotics for treatment,[2] showed parents do not always consider disease as a threat. On some occasions they decide not to use antibiotics to treat the child, believing it would impair the child's immune system or could cause adverse effects. However, exaggerated parental fears, from fever, have been documented for over three decades.[3-6] Most studies have focused on parent's knowledge, practices and beliefs of fever management on their febrile children.[7 8] Some of these beliefs have led parents to over-emphasise consequences from fever, or untreated fever, such as: dehydration, sleepiness, seizure, coma, brain damage or death.[9]

Parents are key to making decisions regarding whether a child can be treated at home or requires further care[10]. In most cases mothers (not fathers) will care for the feverish child,[11] and the majority of illnesses are therefore dealt at home.[12] Less than 20% of illnesses at home experienced by children result in attendance with a professional health provider.[13 14 15] Illness in children differs from adult illness due to their stage of development, and also because young children are not able to exercise their own decision making in health-related matters.

Children are more likely to be taken to see a GP when parents perceive the illness seems to be progressing or not responding to medication.[16] However, on other occasions, parents may take children to a GP with no apparent signs of serious illness. This may be related to parental beliefs of serious infections such as meningitis,[17] regardless of the lack of symptoms. Some parents feel unprepared when their child is sick, and can be frightened or distressed in certain situations.[16 18] Furthermore, research highlights that parents are very afraid when they identify symptoms of fever. They appraise them regularly and may find it difficult to estimate the severity of these signs.[4 19 20]

It has been suggested that parental beliefs about the possible causes of fever vary from infection, to walking on bare feet, changes in the weather,[21] or teething.[22] When mothers identify a fever they also report a range of symptoms such as decreased activity, excessive sweating, restlessness, excessive crying and shivering.[23]

Previous research has shown that individual beliefs of fever may lead some parents to think that fever could rise to dangerously high temperatures if not treated.[11 21 24] Studies have shown that inadequate management techniques were sometimes used such as waking up children to administer medication,[25] providing antipyretic medication to children at low temperature levels,[26 27] using sponging[4 19] or traditional methods to lower fever.[21 28]

Children under 5 years form the largest proportion of workload presenting to primary care.[29] A qualitative study looking into what was of importance for parents when coping with ill young children,[30] found that fever, cough, and the possibility of meningitis were parents' primary concerns when their children became acutely ill. Parents were worried about recognising a serious illness and became more concerned if their child showed signs of discomfort;[30 31] however, parental understanding of the severity of illness was not always correlated with a doctor's assessments.[31] Parents seemed worried about GPs not providing

enough information, which may seem to them vague or unsatisfactory. Parental lack of knowledge of the cause of their child's illness or its management was a source of alarm, and their beliefs of disease and ill health may have an influence on the use of clinical services.[3 32] Understanding parental beliefs of fever and its management may therefore reveal gaps in their comprehension of feverish illness in children under five years of age.

4.2 Rationale for the study

There is currently a lack of knowledge of current parental understanding and beliefs of fever and temperature measurement in the UK.[20 33]

The overall aim of this study was therefore to describe and determine in a primary setting what the current parental understanding and beliefs of fever and temperature measurement in children under five years are. A selection criterion for parents to attend the focus group interviews was to have a child they care for less than five years of age; this was decided by the Research Ethics Committee. The committee proposed children under this age to increase the validity of the findings. Results from this study aimed to understand some of the elements which might help develop an intervention to improve parental and carer performance on temperature measurement, fever care and knowledge of feverish illness in children.

Focus group interviews have the advantage of increasing the degree of spontaneity in respondents' views[34] and provide parents a forum to safely express their views. Moreover, group interviews are useful to access hard-to reach groups, such as ethnic minority groups.

This chapter used two focus group interviews to explore parental beliefs regarding measurement of temperature, what constitutes elevated temperature for children and how to

care for children when this occurs. A questionnaire survey was run alongside the focus group interviews (see Chapter 6 for questionnaire study).

4.2.1 Study objectives

- To understand parents' beliefs and knowledge of temperature measurement
- To assess how parents identify a febrile child
- To explore parental views about fever and its management
- To understand how much parents know about fever
- To explore the ways in which parents learn to manage feverish illness

4.3 Methods

Face to face semi-structured group interviews with parents of children under five years of age were performed to explore their views and beliefs on the management of fever and temperature measurement. Semi-structured interviews were selected (instead of open-ended or structured interviews) as these allowed the use of pre-specified questions and the exploration of new themes based on them.[35] The North Wales (Central & East) Research Ethics Committee (13/WA/238) reviewed the protocol and ethical approval was granted (see protocol, Appendix 4.1).

4.3.1 Recruitment of parents for the focus group interview

Parents were sampled from a single geographic area from the Oxfordshire Primary Care Trust (PCT) in the Thames Valley region of England. To obtain the maximum sample variation, 14 practices and two out-of-hours services were contacted in Oxfordshire. The author visited practices and contacted non-respondents by phone or email; this was done in order to obtain the maximum number of practices involved. Two practices initially agreed to identify parents for the study, of which one recruited all participants (6.3% of all visited NHS trusts).

Parental cooperation was achieved from the participating practice after two GPs and a member of staff from the practice encouraged parents to participate in the study. A poster was displayed in the waiting room explaining the study, and encouraged those who cared for a child under five years of age to ask the receptionist or the doctor for an information pack containing the study information. Participants self-selected themselves for this study, after discussing it with one member of the practice staff and two GPs (JD, RB and RM), who assisted in identifying potential participants. The focus group interviews were formed of two groups of parents. It was anticipated that 6 to 10 parents in each focus group, suggested by previous research,[36] would be an adequate number of participants to run the group interviews and draw some meaningful conclusions. Throughout the focus group interviews the author tried to reflect on emerging themes, and monitored for data saturation. It was agreed in advance that data saturation would be considered when the focus group interview were not able to contribute to new themes or ideas.[37]

Focus group interviews were held in November 2013, at a day and time convenient for all participants, at the Department of Primary Health Care Sciences in Oxford. A room was set with both audio (verbatim) and video (digital camera) recording equipment. Two focus groups were performed during the afternoon and the evening of that day.

The information pack provided the Participant Information Sheet (PIS), an invitation letter and a contact details form (see Appendix 4.2 containing PIS, invitation letter, contact details form and consent form).

Parents were advised to take as long as they needed to decide whether they wanted to participate. After this they were contacted to organise a date and time for the focus group session. Participant's consent for the study was taken on the day of the focus group interview.

Recruitment to the focus groups started when 250 parents and carers completed the questionnaire as suggested by the Research Ethics Committee. Participants' details were checked by the author to ensure study participants fulfilled the inclusion criteria; no carers were included in this study. Parent's contact details were erased once the study was completed but their signed consent forms (see Appendix 4.2) were kept.

4.3.2 Details of the focus group interview schedule

The interview schedule (Appendix 4.3, section A) was developed from previous published research on parental beliefs of fever management[38] and discussed with a qualitative research expert (JE) from the Health Experiences Research Group. One pilot focus group was completed with postgraduate students from the University of Oxford, some of whom were parents. The author performed the pilot study to understand how to adequately conduct a focus group interview and increase his interviewing skills.

The two focus group interviews were conducted in November 2013 and lasted between 30 to 60 minutes (mean 44 minutes). Focus group interviews were recorded with both verbatim and a digital camera and a full transcription of both group interviews was performed by an official transcriber (LS). Transcriptions from both of the focus group interviews were then checked for errors by the author again using both the video and audio recording from the focus groups.

After an introduction from the author on the topic, a focus group interview to explore parental understanding of thermometry and their views about fever and its management was conducted. At the end of each focus group interview participants were asked to add any closing statement in case they wanted to add anything to what was previously covered. Additional questions were incorporated to the initial anticipated themes after successive focus groups (pilot and first focus group). Data relevant to each theme was identified and explored

using the constant comparison method,[39] which was helpful in order to create different codes and redistribute the data into existing or new themes.

4.3.3 Data analysis

Thematic analysis was used to analyse the focus group interviews. The approach used was strongly influenced by Grounded Theory in which theories emerge inductively and are constantly shaped with new incoming data.[40] Parental beliefs of fever and temperature measurements were looked at from an inductive point of view rather than theory verification.[41] The author did not impose his thoughts upon the interviewees and their answers were followed in an explorative manner.

A thematic approach was used to analyse the data, referred to as modified Grounded Theory,[42] where the data is validated through a systematic approach, and data from the parents' interviews was identified and divided into categories as it emerged. These categories were divided in themes which were then matched and confirmed. Once all the data that matched a theme was located, the process was repeated for each one of the themes. This method was used after consulting a qualitative research expert, (JE) from the Health Experiences Research Group, as it seemed appropriate to the framework of semi-structured interviews specific for this study.

The data analysis started after the focus group interviews were transcribed. Each transcript was then read and re-read by the author to gain an overall understanding of parental beliefs and experiences.

Constant comparison method was used to interpret the data, looking for anticipated and emerging themes as the analysis progressed.[39 40 42-45] Deviant cases were also sought and discussed,[40] this method was used in order to strengthen the analysis.[46]

The author coded both focus group interviews to produce a coding structure, coding was subsequently checked by a senior qualitative researcher (SR). The author read through the interview transcripts repeatedly. Thematic analysis of the data was facilitated by NVivo 9 computer software. Data was first identified by initial themes and concepts, these data was informed by previous literature and by examining the information obtained. The concepts and themes were identified and the data was finally sorted by themes.

To help writing the results an "OSOP" or "one sheet of paper" was used. This process involved the author reading through each section of data in turn and noting, on a sheet of paper all different emerging themes that were highlighted by the coded extracts, along with the relevant respondent identification.[45] The correct use of OSOPs by the author was checked by a senior qualitative researcher (SR). A contact summary sheet from each one of the focus group interview that contained general information and author thoughts about the focus group interviews was also created to help writing the results (see codes and contact summary sheets in Appendix 4.3, section B).

To maintain confidentiality, quotations reproduced in this chapter have been labelled with the participants' identification code (e.g. Rv).

Ethical considerations

A research ethics committee (REC) from North Wales (Central & East) reviewed this study and required changes regarding the focus group interview. These changes consisted of not providing any information regarding the NICE guideline or mention of it, as well as the focus group interviews being formed only by parents caring for children 5 years of age or younger. After a re-submission favourable opinion was granted for this study Rec. Ref. 13/WA/238 (see Appendix 4.4).

4.4 Results

Nine parents took part in two semi-structured focus group interviews (four parents in the first one, five parents in the last one) which consisted of 8 females and one male. All parents cared for at least one child five years of age or under, but did not provide information about their age, whether they had more children or their children's age.

All parents were over 18 years of age and from varied ethnic backgrounds living in Oxford (see Table 4.1).

Table 4.1 – Parent's ethnicity

Ethnicity	No.	%
British	1	11.1
British or mixed British	4	44.4
Other white background	3	33.3
Asian	1	11.1

Results from the focus group interviews were divided into three main themes: Experience and knowledge of fever, fever management and thermometry.

4.4.1 Experience and knowledge of fever

4.4.1.1 Experience of fever

Parents associated fever with feelings of worry and expressed panic when they thought their children had a fever. These feelings of fear from fever varied depending on circumstances, when parents thought the fever was lasting long (over a number of hours or days), when the fever was high (e.g. 39 °C) or they thought their child had a more serious condition.

They expressed less worry for increased temperatures (they considered as a fever) when they could identify a specific cause, such as teething or as a direct effect from immunisations. In contrast, they considered it stressful not to know the origin of a fever, as this could be due to

a severe illness. Moreover, three of the parents (one in the first focus group interview and two in the second one) had experienced serious disease and hospitalisation with their children.

Rc: Again it depends on the temperature. Before I go to panic stage it depends how ill they are, how long, the length of time they have had it before I get into panic stage…

Rh: Well just some of the time [baby talking] because I am using it and if it tells me they have a fever of 39 °C then I am going to worry…

Rm: Well usually I'm wondering what has caused it. Mainly these days it is their teeth but usually with the teeth kind of fever it's not that kind that brings their whole body so hot. It's more like a low one so I am more concerned that they are coming down with something exciting…

4.4.1.2 Changes with age

Parental experience of fever with older or successive children was heterogeneous. Most parents thought that as children get older it would be easier to understand the gravity of a fever or a condition. Their explanation was that older children were more able to communicate how they were feeling. The fact that children could express themselves more effectively with increasing age seemed to be a factor that reduced parental feelings of worry. However, some of the participants did not think that once a child was older, they were less concerned about fever, as they had already experienced fevers that had preceded a serious condition. One of the participants mentioned that on the first occasion her child had a fever she would seek further advice, but she would be more prepared to deal with fever subsequently.

Rc: I'd be thinking if they get older then it would be more inclined to handle it better is what I think really but like I said that I've got older and I'm not that experience yet (mumble) …

Rk: I think I do get less worried. I think when your baby is very small it's quite scary if they have a fever. So I think the older they get I don't, I feel that I'm not quite so panicky as I was when she was really little. And I think as she learns to talk. She can't talk yet because she is only just one then it's like Rt says she can be able you know how she is feeling…

Rl: I don't know I have a 13-year-old daughter as well. Last year she had a noro virus so that was quite worrying. So yeah I don't think it gets easier as they get older. Things are still the same, you still sort of worry and. Well I do…

Rm: I am worried and I think that I have gotten more worried as I have more children. I used to be very relaxed about fever but I think that now I worry more. The last time that one of my babies had a high fever it turned out that he had quite a serious disease [baby squealing] So that has made me a lot more nervous now because I know that things can change quickly, from experience things can change very quickly…

4.4.1.3 Knowledge about fever and its cause

Most of the participants expressed a lack of knowledge about fever. Participants considered temperatures of 38 °C and above to be high; however, other parents waited until a child's temperature reached 40 °C before seeking referral. Not all parents mentioned specific temperature thresholds they considered to be a fever; however, a lower threshold for fever of 37.5 °C was suggested, and these temperatures ranged substantially (by 3.5 °C, 37.5 °C to 41 °C).

Parents assumed their children had a fever when they felt they were hot and, they described fever as "heat from the body": most parents thought that fever was damaging. All parents agreed that a high fever or a sustained fever was harmful. Furthermore, some participants agreed that a high fever for any length of time was damaging, and most participants

suggested that fever is always harmful. Nevertheless, two parents thought fever could have some benefits, and one of them mentioned reading about some potential benefits. Parents were also worried about not understanding why their children had a fever, and whether their fever could be an indication of a more serious condition.

Parents expressed concerns that fever could have effects on the body, including reduced function of the brain, blood, kidneys, liver or the body in general. They also mentioned fever could be due to more serious conditions such as chickenpox, meningitis, typhus, tonsillitis, ear infection or stomach bugs. Furthermore, serious consequences of fever such as blindness or dehydration (more frequently) were mentioned.

Rk: I think it depends how high the number is to how panicked you get or what the response would be. If it's just, you know, a low grade fever I wouldn't really give her medicine but if it is like 38 °C I would give her paracetamol or Calpol or something like that…

Rt: With my kid, with his kid was first, every time when he had even a small, like mild fever he had the urine infections so it doesn't matter what kind just how much like lower and higher but now when it's 37.5/38 °C usually I will try it in the ears…

Rc: No way near beneficial I'd say. Harmful yeah can be harmful. I mean I don't know how true it is but I understand that some fevers if they go on a long time it can cause other symptoms like blindness…

Rc: Like I said I've been told before it can cause blindness…

Rm: I realise I don't know much about fever. I think but I do think it can be beneficial in that it is our body's response to something so mmm. One of my children had chickenpox when she was very small, sort of, you know, three or four months old and I did a little reading about it and they did communicate that with a fever for chickenpox there is evidence

that you should let the fever do its thing the chickenpox will be less bad so that made me realise that it could be part of a natural response…

4.4.2 Management of fever

Information on the management of fever was quite diverse and in occasions overlapped with other themes. This section was divided in three subthemes for a better understanding: Information related to fever management, what information and resources parents need to manage fever better and parental fever management.

4.4.2.1 Information related to fever management

The first point of reference for advice about fever for parents was on most occasions the healthcare system. GPs were mentioned as the main healthcare staff they would contact; visiting a paediatrician was also mentioned by one parent. Other professionals, such as health visitors, or healthcare staff at the practices, were considered as information sources. Participants suggested out-of-hours services or A&E as a place to take a child with a fever. NHS direction via NHS Direct or 111 number (NHS emergency and urgent care services) were also contacted by parents over the phone when they were in need of information or instruction about a feverish illness.

Rt: Usually just GP practice. If it is evening or weekend, out-of-hours, like this Outpatients, [out-of-hours GP clinic] or if it's really high we are going to the hospital because anyway he has still something that we can worry about we have to be seen by some paediatrician…

Rh: Well if it is in working hours I will call my doctor first and health visitor. If it's not the same time, A&E or NHS direct (laugh) because if I can give them a call on 111 they will tell you, they will give you advice and give you a phone number for out-of-hours if they have to be seen by a doctor…

Rm: If I am concerned then I usually will call, it's almost always at night so I will call NHS Direct but if it's in the day then I call my GP and ask for advice…

Family members were the second most referenced source of advice. Grandmothers ("mum, granny or mother-in-law") were quoted on a number of occasions as direct helpers with the child's fever, informing and supporting parents during the illness. Family members such as grandfathers, husbands, sisters or friends were mentioned to a lesser extent by parents when advice was needed.

Rc: If I am very honest the first point of contact would be my mum. In all honesty that's just for any advice. Depending on how bad it would be for advice. Obviously Mum's older than me, she understands a lot more so maybe she can explain to me a lot then. If not then certainly my contact would be doctor, GP…

Rj: So during the day probably the GP but at night I would have to, I'd phone my Mum first and make sure she is on standby so when I've phoned NHS Direct and I have to go somewhere. She could take care, or she could like drop me off there or if my husband isn't at home he could like come back from work and things…

Rh: Sometimes, if they have a fever suddenly if they are alright during the day and in the night they have a fever I am worried because particularly about typhus and meningitis about these things. And I asked my mother-in-law, her granny she helps me a lot. If they've got a fever I take her quickly to them and ask her to look at them if they are ok or if she is. She tries to just calm me down, you know, 'Don't you worry, don't cry go to your Mother or sister or a doctor…

Parents' descriptions of length of a fever were heterogeneous. Some of the parents thought that fever could last for a few hours up to a week and one participant said her child had fever for months in an occasion. In terms of length of fever, duration of 6 hours or more prompted participants to think about visiting a GP or to intervene. All parents agreed that fever can last several days, after which point all participants would be worried or very worried. The length

and height of fever were factors combined when considering the seriousness of feverish illness. Fever prompted some of the parents to think about specific infections such as tonsillitis, urine or ear infection and look for signs of more seriousness.

When participants felt their children had a very high temperature they wanted to consult a GP. However, at times or days where this occurred, and GP practices were closed, parents visited out-of-hours services instead.

Rc: The length, if it was a normal day I'd say more than 6 hours, if it carries on more than 6 hours then I would start to worry and start to look into something, getting some medicine or maybe go to the doctor's or something like that

Rh: Then afterwards she had an ear infection and then last year when I took her abroad then she had a really bad fever for 3 months

4.4.2.2 What information and resources parents need to manage fever better

All parents agreed that they needed more information about fever and its management, and wished to be given information early on a child's life. They required information about fever in general, as well as more specific advice on how to deal with it efficiently. Participants wanted to understand specific information of "fevers" that can precede more serious conditions, and wanted it to be up to date. They were keen to understand specific symptoms, such as the height or length of fever they should look for as a pattern for disease (see Table 4.2).

Table 4.2 – Information required by parents

Information about fever in children*	Information about fever management*
General information about fever	How to care for a child with a fever
Height of fever that can be a sign of a more serious condition	How to care for a child with a high fever
Length of fever that can be a sign of a more serious condition	When is necessary to seek further care in the case of feverish illness
Other signs that can be a symptoms of a more serious condition	What to do if the child does not get better with medication
Which thermometers should be used and on which body sites for a correct measure	

* Parents thought this information should be given to them as a standard when they have a child

Not all participants were sure which thermometer was the best to measure temperature, or which sites should be used. Parents felt confused with the existence of different thermometers and sites where to measure temperature and asked for advice on this matter. Furthermore, parents did not understand what could cause a high fever i.e. 40 °C and information about care when high temperatures occurred was sought.

Some parents expressed concern about advice given to them by some GPs about fever management i.e. use of cold baths to lower fever, as they said this seemed to be contrary to guidance given to them by other sources. Participants' views on information obtained from the internet were diverse, some considered the internet a resource with useful information, and others thought the internet to be an unreliable source that increased fears of disease ("scaremonger").

Rk: I think that it would be great to know. You should be worried if your child has a temperature of this for more than this many hours like at the moment it's kind of just what each parent decides so if they can say, 'Be worried or phone us if your child is 38 °C for 6 hours' say for instance but at the moment nobody says, 'Oh you should be worried if it's this temperature or whatever. It's just kind of up to everybody to decide when to panic…

Rr: What I need to do but when it gets like 40/40.5 °C I will contact NHS Direct because if you need to go to out-of-hours you cannot go right with them and be like that…

Rc: And speaking as a parent there are general things that you need to know there at some stage as a parent. I think there should be some sort of manual. I'm not saying it should be rammed down anyone's throat. I'm just saying there should be a manual where you can to go back to, look it up and think, 'Ok, then I know what I am doing here, got this, got that'. I think there should be sort of manual something like that…

Rm: I think what I need to know and that I don't know is to what degree I should be concerned, when I should be worried. You know, is there a situation in which a fever can be left to do what it needs to do? What are the real sort of signals that something else is wrong?

Is fever by itself cause a problem or is it, you know. I do know that obviously, you know, certain kinds of rashes are worrying and this kind of thing. But thinking about it I think what I really need to know about managing a fever, and feeling more confident is when should I be worried? What are my signals? Always be worried, always want their temperature to come down or is it only when it reaches a certain point or it lasts a certain amount of time or something…

Rk: I think that sometimes doctors give information that is not up-to-date like put your baby in cold water which is not good. We've been told that when we've been to out-of-hours before in [out-of-hours GP clinic] and luckily I knew that was not the right thing to do so we didn't do it but I think that's not good, especially even though this sounds bad the older doctors are not seen to be giving out advice that is not up-to-date…

Rc: No not really I tend not to believe the Internet. I find that being very contradictive which is partly what the doctor says. I think the Internet is very contradictive…

4.4.2.3 Parental fever management

Most parents believed fever was harmful and they needed to reduce it. Some parents would initially check the fever and how it developed, before taking action.

The majority of parents said they used medication to reduce fever. The most used drug being paracetamol followed by ibuprofen. None of the parents mentioned the dosage of medication they gave to their children, but on some occasions, how frequently they provided it (every four hours or alternating antipyretics every two hours). Some parents said they administered antipyretics all the time. These parents tried to administer the maximum permitted drug doses as long as they felt their child was not recovering.

In this respect, some of the parents mentioned they combined both paracetamol and ibuprofen, one of these parents acknowledged that she was told that using these drugs in combination would better control a fever. However, medications were used with prudence by some of the participants; one participant expressed concern about a specific medication

(Neurofen, ibuprofen) as she was told about its potential harmful effects on children's health. Another parent said she could not use certain medication (Calpol, paracetamol) as it made her child sick, this parent used paracetamol suppositories (these were also mentioned by another parent) obtained from another country when he was sick.

Physical methods in order to reduce fever were used by all parents, most frequently by reducing layers of clothing. Participants also used ingested cooling methods such as cool drinks or gave popsicles. External cooling methods included the use of cool clothing (or a face flannel) on the child's forehead. Tepid water bath was also mentioned by several parents, and by one of them as the very first method to reduce the fever before using medication. One of the parents said she used to "splash water" on her child, while the child had her feet in water. One alternative method to reduce fever was using vinegar on a cloth, and sponging the child with it.

Rk: Well I don't know if it is the right thing but we've been told that if there is a fever of 38 °C or above you can alternate Calpol the paracetamol and ibuprofen so you manage the fever better using a combination of the two rather than just ibuprofen or paracetamol and to let them wear as little clothes as they need, that kind of thing…

Rt: When the fever is really high like 38 °C or something suppositories with paracetamol. I think it is really rare here to find it here but for less than 40 minutes the fever going down and he is fine because sometimes Calpol doesn't work with him. Calpol even upset his stomach so is not good for him he does not want to eat Calpol is fine but takes longer time to bring the fever down. If there is less fever, yes Calpol is fine but if it's over 38 °C I use suppositories…

Rc: For me normally I get the old wet flannel across the forehead. I just keep watching them, stay by them, and keep watching them…

Rh: I was worried about that that's why I give them ibuprofen all the time. And they tell me, 'Just leave her in a nappy or put her in a cool bath because her fever was not coming down…

Rr: Yes the shower is the first thing then. First I try the Neurofen but if the Neurofen can't do it I, it's the shower. She is going straight to the shower and then we put no heating as well and I will put towels around her forehead and around the neck and keep giving him water because he has got like high fever. He'll be acting like every 15 minutes, 'Water, water'. If he is, if the fever is really high he will be like sick three or four times within the night…

4.4.3 Thermometer use

Some parents felt comfortable using a thermometer, these parents seemed to use thermometer at the same site or sites consistently. Using the thermometer in the same body site was considered by a parent as a measure of "relativity", this seemed to enhance feelings of self-assurance when identifying an abnormal body temperature. Parents seemed to rely on the thermometer to give an accurate measure which they perceive helped them identify serious illness.

In contrast, parents who were not comfortable using a thermometer, did not own one. They were often confused how to use the different types of thermometers, the measuring in different body sites or were confused about the combination of both which created anxiety. These participants did not know what to do with the information, once they had obtained it from the thermometer reading.

Thermometer types that parents said they used included digital thermometer (under arm), forehead thermometer and ear (infrared) thermometer. However, some parents used more than one type of thermometer.

Rc: No I don't have a thermometer. In all honesty I don't think I'd really understand how to use it or where to use it in the situation…

Rm: I have a thermometer but I don't always feel comfortable using it because I am not sure about how [noise in background] to check the number that I have because I have had other bigger ones that take the temperature in different places and I never know. I know that there are differences depending on where you are taking it. I never quite know what to do with the information…

Rt: It gave us a different measurement like [um] in her forehead it's ok and for his case it was in his butt [ha] like when you put it underarm thermometer because it was the right one, underarm and ears was totally (un)useful for me the first year…

Rt: I'm not sure which is the right one. I know that underarm is cool but it doesn't. Sometimes it doesn't show any measurement. Ears and forehead have so I am not sure which one is right so I have to guess…

Rk: I do. I have a digital ear thermometer. I kind of always take it in the same place even if it is not accurate I have a measurement of relativity so I know what it usually is in that place so I know if it goes up then I am always taking it in the same place…

4.5 Discussion

Parents' views and actions in the light of fever were influenced by their beliefs and sources of information and advice. Some participants did not know what a fever was, the physiological mechanisms underpinning a fever, and on most occasions did not have a perception that these mechanisms could be associated with immunological benefits.[47] [48] Fever was considered detrimental towards the child's health and therefore it was seen as necessary to be reduced.

The main findings from this study can be summarised as:

- Parents had limited knowledge about fever

- Parents who had older children were less anxious about fever

- Parents were not sure how to take temperature measurements

- Parents provided all medication that was allowed to reduce temperature

- Parents mentioned the existence of contradictory sources of information

4.5.1 How it fits with the existing literature

Parents have limited knowledge about fever

Parental knowledge of fever seemed limited. No participant gave specific temperature thresholds that corresponded with a fever and these temperatures ranged by varied markedly; however, parents considered a temperature of 38 °C a high or a very high fever.[9 26 33 49]

Fever was associated with worry and anxiety, with the exception of fevers believed to have come from benign origins (i.e. teething). Whenever parents thought their children had abnormally high temperatures, they were concerned about the consequences, such as brain damage, or dehydration.[6 19 50 51] Some parents were also worried that high fevers may be related to more serious infections such as meningitis. Moreover, parents agreed that fever contributed to a slower body functioning in specific organs (i.e. brain, liver, limbs) and in the body in general.

Participants did not seem to understand what a fever was or how to define it.[4 9] It was described as “heat from the body” or “having a hot body”. The finding that parents thought a high fever was harmful for the child concurs with previous studies in this area, which found

that parental thoughts of adverse effects from fever are common;[3 4 6 9 19 21] within the interviews parents believed a high fever was detrimental for any length of time. However, not all parents thought fever was damaging and some suggested potential benefits from it. Few studies to date have reported carers suggesting some benefits from fever itself[26 50] or fever as a warning signal.[38]

Parents who had older children were less anxious about fever

Having older children seemed to decrease parental anxiety over a feverish illness, participants suggested they were more prepared to deal with a feverish illness after they have dealt previous experience. This was not the case when parents had past experiences that led to more serious sequalae. Furthermore, previous research has suggested that caregivers who were very worried about fever were more likely to check a child's fever more often.[9] Conversely, parents of young children have been shown to have a higher threshold for what they considered to be a fever.[3]

Parents were not sure how to take temperature measurements

Parents used different body sites to measure temperature on a child, including: underarm, forehead, ear or rectal, whereas only axillary and ear measurements are recommended by the NICE guideline in children under five.[10 52]

Understanding how to use a thermometer was not common knowledge and some participants were not sure if they were taking a temperature correctly. Another concern was understanding how they should use temperature readings to help them identify a fever and better care for a feverish child.

Importantly, those who did not own a thermometer suggested they were confused with the different variety of thermometers available.

Parents administered the maximum recommended antipyretic dose to reduce temperature

Some parents mentioned they wanted to provide as much medication as allowed, in order to reduce fever, whereas a few were concerned about possible damaging effects from medication. Previous research has suggested that parents may administer antipyretic doses which are either very low, very high, or in doses which are administered too frequently.[53 54]

Participants' understanding of fever was related to the manner in which they managed it, when they felt a fever required action this was treated immediately. Parents actively tried to reduce fever using both antipyretic medication and cooling techniques. Most parents gave paracetamol or ibuprofen to their children when they felt they had a fever. These findings seem to be in line with previous research suggesting paracetamol[55] together with ibuprofen[53] are the most common antipyretics used by parents. One of the administration methods included suppositories.

When parents mentioned how often they administered medication they mainly mentioned every four hours paracetamol or alternating every two hours paracetamol and ibuprofen. Alternating antipyretic medication has been suggested as a parental way to control fever.[10 52]

Research has suggested that alternating antipyretics may increase the likelihood of making mistakes in antipyretic use, with 27% of parents alternating antipyretics[9] and only one in 7 children reported as correctly receiving the alternated medication.[53] However, a recent study has shown alternating antipyretic medication to be a common practice,[56] nevertheless just over half of caregivers (61%) have been given instructions by healthcare providers on how to use this technique.[57]

Parents mentioned the existence of contradictory sources of information

On occasions participants mentioned the existence of contradictory sources of information. These contradictory sources included GPs or the internet; conflicting advice was related to fever management, and recommendations ranged from bathing or not bathing, sponging or not sponging. Parents in the focus interview mentioned they had to exercise their judgement in these cases. However, if current help from GPs provide conflicting information this may be a source of further anxiety.

Participants wanted information from GPs and broader NHS healthcare resources on the interpretation and management of fever, as they thought this advice would be useful. The information they required was specific and practical. They also wanted to know signs and symptoms that helped them to identify serious diseases that may require further care, or how to care for a child at home.

4.5.2 Implication for further research

A further study looking at parents across a wider sample of practices could have identified whether parental views reported in this study were widespread or diverged across different sociodemographic groups.

Further studies incorporating healthcare professionals' (e.g. GPs, practice nurses, health visitors and practice staff) views on parental understanding of fever and temperature measurement may help provide a more comprehensive and overall view on this topic. This would also help to understand whether appropriate advice is offered to parents.

Understanding whether thermometer ownership makes parents more likely to measure temperature could be explored. This research may help understanding whether those parents who own a thermometer may be more comfortable using it.

In addition, confirming whether GPs are giving conflicting advice and whether they sometimes promote or increase anxiety is worthy of exploration.

4.5.3 Limitations

This qualitative study aimed to recruit a maximum variation sample, rather than a representative sample, parents in the focus groups had different educational and ethnic backgrounds which increased variation. Only one practice participated from all the 16 NHS GP clinics the author approached within Oxfordshire. Two parents dropped out the day of the focus group interviews and this reduced the number of participants. However, the study is nevertheless perceived successful by the author in sampling a range of views.

The sampling in this study may not be representative of the whole population; this was due to (as suggested above) the limited availability of both practices and out-of-hours departments that wanted to participate. Another limiting factor was that all participants had to be parents of children up to five years of age, due to the inclusion criteria stated by the research ethics committee for this study. Furthermore, parents were asked for about a full hour of their time for the focus group interview alone and the fact they have very young children to care for may also be a cause of their low participation. For this reason child care was offered to participating parents.

Exploration of beliefs about fever management and thermometer usage were very similar in both focus group interviews; however, further focus groups would have been useful to understand whether data saturation was reached. In order to get all patients involved most questions were asked to all parents, and parents had interaction with each other and their answers may have therefore influenced each other’s answers.

Parental participation in the study was achieved thanks to the effort of two GPs and a member of staff from their practice. This may have had an effect upon the specific sample of parents

attending the interviews; furthermore, volunteering parents may have had a particular interest in increasing their understanding of the care of feverish illness in their children. It is therefore possible that the study did not identify parents without such an interest.

Respondent validation was not used to check the data obtained, however negative views were further explored. The full transcripts were only read by the author. Coding was performed by the author and checked by a senior member of the qualitative team (SR), however no other person reviewed the coded transcripts.

Participants were made aware that the study was part of a doctoral research in which a student was the principal investigator; furthermore, the study was an independent study research separated from their practice. Participants were provided with a consent form and a participant information sheet which described that no information from the focus group interviews would be disclosed to any third party. However, parental responses may have been modified, particularly if they thought staff at their practice would share this information.

The author performed, to the best of his ability, by acting as a moderator and not providing any leading information to participants about fever or measuring temperature. Nonetheless, the author's attitude and motivation towards the specific research subject, may have shaped some of the participant's views. Additionally, the author was of Spanish origin and had a characteristic Spanish accent, even though the group was heterogeneous and there were parents from different ethnic groups this may have had an effect on participants' responses.

Parents attending the focus group interviews were offered child care support funded by the author's department. However, participants from the second group interview opted to bring four children to the room while the study was being carried out (a two months old baby and three children under the age of five). Two of the children were on occasions talking and

running around the room. However, this had almost no effect on the smooth running of the study as parents tried to calm down their children when this occurred.

Parents attending the focus groups were from different ethnic groups. Generalizability to other settings may therefore depend on represented ethnic groups in different settings.

4.5.4 Conclusion

Most parents believed that fever was a harmful condition that may be linked to a more serious disease. However, they did not know what a fever actually was, and felt at ease when they thought it may be due to a benign cause. Parents became anxious when it first appeared, and they did not know its cause. Those parents who did not own a thermometer were not comfortable using one, because they could not understand its proper use. This was due to the variety of devices and different body sites they could be used at. Most of those who owned one seemed to rely on the thermometer to provide an accurate measurement.

Antipyretic medication was used promptly by parents. They made sure their children were administered all the antipyretics they thought their children needed (and they were allowed to provide) to reduce the fever, as well as alternating them in order to maximise their effect. Nevertheless, some apprehension was shown by their beliefs and individual experiences about complications from antipyretic medication. Antipyretic therapy, which was the first resource used by most parents to combat fever, was often used in conjunction with cold flannels, sponging and bathing to decrease body temperature.

Parental information sources about fever were heterogeneous; in the majority of cases they sought advice from a GP. Parents also sought advice from relatives closer to them or sources like the internet or NHS phone lines. Those who had older children or more than one child though they had become less concerned about fever; however, this feeling was entirely dependent on past experiences.

Parents wanted to be provided with specific and practical information on the identification of fever and diseases that precipitated it. They also wanted to understand its management and how to better recognise conditions requiring immediate healthcare attention.

Advice could be made readily available to parents at primary care level, ensuring that this information is consistent and in alignment with NICE guideline recommendations for the care of a feverish child. This could be a simple intervention to implement in Primary Care.

It is clear that parents should be made aware that information about fever, its management and temperature measurement already exists; this information should be conveyed to them in an easy manner for their understanding of fever and its care.

4.6 References

1. Leiser D, Doitsch E, Meyer J. Mothers' lay models of the causes and treatment of fever. *Social Science and Medicine* 1996;43 (3):379-87.
2. Jónsson H, Haraldsson RH. Parents' perspectives on otitis media and antibiotics A qualitative study. *Scandinavian Journal of Primary Health Care* 2002;20(1):35-39.
3. Kramer MS, Naimark L, Leduc DG. Parental fever phobia and its correlates. *Pediatrics* 1985;75(6):1110-3.
4. Schmitt BD. Fever phobia. Misconceptions of parents about fevers. *American Journal of Diseases of Children* 1980;134 (2):176-81.
5. Knoebel EE, Narang AS, Ey JL. Fever: To Treat or Not to Treat. *Clinical Pediatrics* 2002;41(1):9-16.
6. Gunher Arica S, Arica V, Onur H, Gülbayzar S, Dağ H, Obut Ö. Knowledge, attitude and response of mothers about fever in their children. *Emergency Medicine Journal* 2011.
7. Ames J, Hayden GF, Campbell RE, Lohr JA. Parents' conception of their use of over-the-counter medicines. *Clinical Pediatrics* 1982;21(5):298-301.
8. McErlean MA, Bartfield JM, Kennedy DA, Gilman EA, Stram RL, Raccio-Robak N. Home antipyretic use in children brought to the emergency department. *Pediatric emergency care* 2001;17(4).
9. Crocetti M, Moghbeli N, Serwint J. Fever phobia revisited: Have parental misconceptions about fever changed in 20 years? *Pediatrics* 2001;107 (6):1241-46.
10. NICE. Assessment and initial management of feverish illness in children younger than 5 year. *BMJ* 2007;334(7604): 1163–1164.
11. Hernandez J, Heneghan C, Thompson M, Ward A, Gill P, Moscrop A, Roberts N. Parents use and interpretation of thermometry in children: a systematic review *Part of DPhil Thesis* 2012.
12. Bruijnzeels MA, Foets M, van der Wouden JC, Van den Heuvel WJ, Prins A. Everyday symptoms in childhood: occurrence and general practitioner consultation rates. *Br J Gen Pract* 1998;48(426):880-4.
13. Holme CO. Incidence and prevalence of non-specific symptoms and behavioural changes in infants under the age of two years. *British Journal of General Practice* 1995;45 (391):65-69.
14. Dahlquist G, Sterky G, Ivarsson J-I, Tengvald K, Wall S. Health Problems and Care in Young Families—Load of Illness and Patterns of Illness Behaviour. *Scandinavian Journal of Primary Health Care* 1987;5(2):79-86.
15. Practitioners RCoG. Birmingham Research Unit: Weekly Returns Service Annual Prevalence Report 2007. 2008.
16. Ertmann RK, Söderström M, Reventlow S. Parents' motivation for seeing a physician. *Scandinavian Journal of Primary Health Care* 2005;23(3):154-58.
17. Kai J. What worries parents when their preschool children are acutely ill, and why: a qualitative study. *BMJ* 1996;313(7063):983-6.
18. Hendry SJ, Beattie TF, Heaney D. Minor illness and injury: factors influencing attendance at a paediatric accident and emergency department. *Archives of Disease in Childhood* 2005;90(6):629-33.
19. Sakai R, Okumura A, Marui E, Niijima S, Shimizu T. Does fever phobia cross borders? The case of Japan. *Pediatrics International* 2011:no-no.
20. Blumenthal I. What parents think of fever. *Fam Pract* 1998;15(6):513-8.
21. Crocetti M, Sabath B, Cranmer L, Gubser S, Dooley D. Knowledge and management of fever among Latino parents. *Clin Pediatr (Phila)* 2009;48(2):183-9.
22. Boivin JM, Weber F, Fay R, Monin P. Management of paediatric fever: is parents' skill appropriate?. [French]. *Archives de pediatrie : organe officiel de la Societe francaise de pediatrie* 2007;14 (4):322-29.
23. Al-Nouri L, Basheer K. Mothers' perceptions of fever in children. *J Trop Pediatr* 2006;52(2):113-6; discussion 17.
24. Erkek N, Senel S, Sahin M, Ozgur O, Karacan C. Parents' perspectives to childhood fever: comparison of culturally diverse populations. *J Paediatr Child Health* 2010;46(10):583-7.

25. Al-Abdel Jalil HK, Jumah NA, Al-Baghli AA. Mothers' knowledge, fears and self-management of fever: A cross-sectional study from the capital governorate in Kuwait. *Kuwait Medical Journal* 2007;39 (4):349-54.
26. Rendon-Macias ME, Tellez-Leon G, Reyes-Valencia G, Apresa-Garcia T. Fever phobia: As a cause of overtreatment in children. [Spanish]. *Boletin Medico del Hospital Infantil de Mexico* 1996;53 (8):374-84.
27. Moraga MFJ, Horwitz ZB, Romero SC. Fever phobia: Parents' knowledge and attitude towards fever. [Spanish]. *Revista chilena de pediatria* 2007;78 (2):160-64.
28. Abdullah MA, Ashong EF, Al Habib SA, Karrar ZA, Al Jishi NM. Fever in children: diagnosis and management by nurses, medical students, doctors and parents. *Annals of tropical paediatrics* 1987;7 (3):194-99.
29. McCormick A FDaCJ. Morbidity statistics from general practice: fourth national study, 1991–92.London: HMSO. In: Office HMsS, editor, 1995.
30. Kai J. What worries parents when their preschool children are acutely ill, and why: a qualitative study. *BMJ* 1996;313(7063):983-86.
31. Kai J. Parents' difficulties and information needs in coping with acute illness in preschool children: a qualitative study. *BMJ* 1996;313(7063):987-90.
32. Becker M, Nathanson C, Drachman R, Kirscht J. Mothers' health beliefs and children's clinic visits. *J Community Health* 1977;3(2):125-35.
33. Purssell E. Parental fever phobia and its evolutionary correlates. *Journal of Clinical Nursing* 2009;18 (2):210-18.
34. Sim J. Collecting and analysing qualitative data: issues raised by the focus group. *Journal of Advanced Nursing* 1998;28(2):345-52.
35. Murphy E, Dingwall R, Greatbatch D, Parker S, Watson P. Qualitative research methods in health technology assessment: a review of the literature. *Health Technol Assess.* 1998;2(16):iii-ix, 1-274.
36. MacIntosh JA. Focus groups in distance nursing education. *Journal of Advanced Nursing* 1993;18(12):1981-85.
37. Francis JJ, Johnston M, Robertson C, Glidewell L, Entwistle V, Eccles MP, et al. What is an adequate sample size? Operationalising data saturation for theory-based interview studies. *Psychology & Health* 2009;25(10):1229-45.
38. Walsh A, Edwards H, Fraser J. Influences on parents' fever management: beliefs, experiences and information sources. *J Clin Nurs* 2007;16(12):2331-40.
39. Pope C, Ziebland S, Mays N. Qualitative research in health care. Analysing qualitative data. *Bmj.* 2000;320(7227):114-6.
40. Strauss A CJ. *Basics of qualitative research: grounded theory procedure and techniques,* 1990.
41. Cutcliffe JR, Stevenson C, Jackson S, Smith P. A modified grounded theory study of how psychiatric nurses work with suicidal people. *International Journal of Nursing Studies* 2006;43(7):791-802.
42. Charmaz K. *Constructing Grounded Theory: A practical Guide through Qualitative Analysis*: Thousands Oaks, CA: Sage Publications, 2006.
43. Holloway I. *Qualitative research in health care*: Open University Press, 2005.
44. Patton M. *Qualitative research and evaluation methods*: Thousands Oaks, CA: Sage publications, 2002.
45. Ziebland S, Chapple A, Dumelow C, Evans J, Prinjha S, Rozmovits L. How the internet affects patients' experience of cancer: a qualitative study. *BMJ* 2004;328(7439):564.
46. Sage Publications I. *Negative Case Analysis. The SAGE Encyclopedia of Qualitative Research Methods. SAGE Publications, Inc*. Thousand Oaks, CA: SAGE Publications, Inc.
47. Kluger MJ, Kozak W, Conn CA, Leon LR, Soszynski D. The adaptive value of fever. *Infectious disease clinics of North America* 1996;10(1):1-20.
48. Kluger MJ, Kozak W, Conn CA, Leon LR, Soszynski D. Role of Fever in Disease. *Annals of the New York Academy of Sciences* 1998;856(1):224-33.
49. Stagnara J, Vermont J, Durr F, Ferradji K, Mege L, Duquesne A, et al. [Parents' attitudes towards childhood fever. A cross-sectional survey in the Lyon metropolitan area (202 cases)]. *Presse Med* 2005;34(16 Pt 1):1129-36.

50. Sarrell M, Cohen HA, Kahan E. Physicians', nurses', and parents' attitudes to and knowledge about fever in early childhood. *Patient Educ Couns* 2002;46(1):61-5.
51. Karwowska A, Nijssen-Jordan C, Johnson D, Davies HD. Parental and health care provider understanding of childhood fever: a Canadian perspective. *CJEM* 2002;4(6):394-400.
52. NICE. Feverish illness in children: Assessment and initial management in children younger than 5 years (guidance), 2013.
53. Li SF, Lacher B, Crain EF. Acetaminophen and ibuprofen dosing by parents. *Pediatric emergency care* 2000;16(6):394-97.
54. Goldman RD, Scolnik D. Underdosing of acetaminophen by parents and emergency department utilization. *Pediatr Emerg Care* 2004;20(2):89-93.
55. Goldman RDS, Dennis. Underdosing of Acetaminophen by Parents and Emergency Department Utilization. *Pediatric Emergency Care:* 2004;20(2).
56. Smith C, Goldman RD. Alternating acetaminophen and ibuprofen for pain in children. *Can Fam Physician.* 2012;58(6):645-7.
57. Wright AD, Liebelt EL. Alternating antipyretics for fever reduction in children: an unfounded practice passed down to parents from pediatricians. *Clin Pediatr (Phila).* 2007;46(2):146-50.

Chapter 5 Assessment of different thermometers available to parents and carers: A cross-sectional study of thermometers

5.1 Introduction

Research has suggested that the content, presentation and distribution of information about medicines should be more rigorously evaluated to identify feasible and cost-effective ways to successfully educate patients.[1] For written education to be effective it has to be read and understood. Information leaflets that are distributed with medical devices may have important roles to provide such clear and understandable information. In situations of self-medication this role becomes more important, which is exemplified by adherence to thermometer instructions for the correct interpretation of measurements. Correct and clear information about the use of the thermometers using clear headings, and explanatory pictures can help users to utilise and interpret measurements correctly.

The current literature on information contained within leaflets from medication and medical devices highlights three main problems: poor use of language, inaccuracy of the information and a lack of user understanding. In this study only accurate content of thermometer information was assessed; there was no analysis of language and user understanding.

5.1.1 Poor language of the information presented

Reading medical information can be a complex process. Understanding is influenced by textual presentation (organisation, print, illustrations and print size), situation (stress), along with reader characteristics (motivation, maturity, knowledge) and patients' understanding of medication leaflets, which may be limited.[1] The word length and complexity of the information with medical terms may not take into account a lay reader, thereby increasing the difficulty of the text.[2]

5.1.2 Inaccuracy and coverage of the information contained

Studies[3 4] have highlighted the need to improve the readability and comprehensiveness of package inserts. Often non-quantifiable phrases in the dosage instructions in reference to the frequency of the side effects make it difficult for patients to understand medication instructions and risks.

A study on the evaluation of readability and accuracy of information leaflets in general practice, for patients with asthma,[5] showed that up to 20% of the leaflets contained inaccurate or misleading statements compared to accepted guidelines.[6] A survey[4] showed that package inserts available on the German drug market did not include important information and were difficult to read or understand. For 74% of the inserts, the daily maximum dose was missing and 63% gave no information on the measures to take for possible interactions. Furthermore, often unclear statements such as "high dosage" or "take 2 - 4 tablets, 1 - 3 times daily" were mentioned in package inserts. A survey looking at information in leaflets from antidepressants in the UK found[7] that information was very heterogeneous. Half did not provide basic information such as how the medicine works or drug interactions. This survey suggested patient information leaflets need to be more standardised in content and contain more information that is wanted by and is useful to patients.

5.1.3 Lack of user understanding

A survey of Italian patients in pharmacies found that 84% claimed they always or often looked at the package inserts.[8] Among those who did not read the package inserts, 46% (7% of all the participants) said they did not read the inserts as they could not understand it. Moreover, these results are in line with a US study[9] that reported 9.3% of patients did not understand the medication leaflets. Furthermore, an interview study suggested mainly negative attitudes from patients towards package inserts,[10] concluding that reading the package inserts did not influence medication adherence. A questionnaire about written medication information for patients, sent to GPs, showed that 30% of GPs estimated over half of the patients read the leaflets and that 75% of them develop symptoms after reading them; as a result most GPs had negative beliefs towards providing written information for patients.[11] Furthermore, an Italian survey looking at package inserts from contraceptives, suggested poor explanations and lack of quantitative data may lead to negative connotations of medication by patients.[12] A study on patient information on nebulised antibiotics, specifically designed for patients with non-cystic fibrosis bronchiectasis,[13] proved worthwhile in creating a leaflet providing consistent information based on best practice and current research. This leaflet was available in a variety of formats and languages and the study suggested it was able to inform a wide range of readers. This study proposed that carer inability to read written information on how to use a device could have a detrimental effect in terms of lack of understanding and accurate use.

Information should, however, meet the requirements and specific understanding of users,[14] which may be an average parent or a carer.

5.1.4 Thermometer packaging and leaflet information

It is equally important that information on medical devices available on the market and intended to be used by patients at home needs to be understandable.[15] [16] [17] Thermometers are

one of the most commonly used medical devices. However, to the author's knowledge no research has been conducted on thermometer inserts. A wide variety of thermometers are available on the market. A 2005 report from Medicines and Healthcare Products Regulatory Agency (MHRA)[18] cited a list of 55 models of stand-alone thermometer (i.e. portable) that are available on the UK market.

Thermometer packaging and instructions may therefore represent a key source for parental and carer knowledge and the interpretation of temperature and fever. Advice from NICE guidelines, on the management of feverish illness in children,[19 20] recommends using specific types of thermometers depending on their age. The guideline also suggests temperature thresholds that may indicate an increased risk of severe illness and advice on the care of fever in children.

This chapter will explore the hypothesis that thermometer information is incomplete and does not reflect current evidence based guidelines (i.e. NICE guideline). The null hypothesis, in contrast, suggests that thermometer information may be complete and based on current evidence based guidelines.

5.2 Rationale for the current study

As noted in Chapter 2, numerous studies have recognised the lack of parental knowledge on temperature measurement and fever management.[21-24] However, research has shown that education programmes on fever management, where written information is delivered to parents, can help increase parental knowledge and care of feverish illness in children.[25-27] In addition, thermometer packaging and leaflet instructions that accompany thermometers may be a primary source delivering information to parents and carers about the care and management of feverish illness.

5.3 Study objectives

5.3.1 Aim

To assess the consistency of advice from information in thermometer packaging and/or leaflets (inserts) for thermometers (which I will refer to from now on as “thermometer information”) that are commercially available to parents and carers, with respect to evidence-based guidelines for feverish illness in children under five years of age.

5.3.2 Objectives

General objectives

- To determine the presence and content of packaging inserts accompanying thermometers obtained over the counter.

- To identify whether the information contained has consistency with that in the NICE guideline.

Specific objectives

1) Describe the types of thermometers available to parents and carers in the main health stores, pharmacies, stores and online.

2) Determine whether the thermometer information provides parents and carers with sufficient advice about their use and adequate safety recommendations.

3) Determine whether information accompanying available thermometers on the market varies depending on their cost.

4) Determine whether advice on thermometer use is consistent with recommendations provided by NICE guidance.[19 20]

- Electronic or chemical at the axilla

- Infrared at the eardrum

5) Determine the information provided regarding temperature thresholds contained in the packaging and thermometer inserts, and, relate its consistency with NICE guidance. For the purpose of the guideline, fever was defined as ‘an elevation of body temperature above the normal daily variation’, which, for inclusion criteria in the studies it was defined as a fixed body temperature of ≥ 38 °C or higher.

5.4 Study Design and Methods

5.4.1 Plan of investigation

This study is a survey of information from thermometers commercially available in pharmacies, shops, toy stores and the internet that can be obtained by parents and carers in the UK. The information obtained from thermometers was used to inform a further study (focus group interview) described in Chapter 4, was undertaken to understand the most usual devices available on the UK market and the information they contain. It will also help develop an intervention to improve parental and carer performance on temperature measurement, fever care and knowledge of feverish illness in children.

5.4.2 Thermometer search and acquisition

Internet searches were used in order to locate all pharmacies and main shopping centres in Oxford. For convenience sampling the city of Oxford was divided into 7 different locations for this study (Headington, Marston, Blackbird Leys, Summertown (including Woodstock Rd), Botley Road, Cowley and Oxford city centre) (see Appendix 5.1). All pharmacies and main shopping centres were then visited in person by the author to purchase thermometers, in February 2013.

Thermometers were also searched for in pharmacies and main shopping centres (Tesco (Tesco Metro and Tesco express), Sainsbury's, Boots, Lloyd's pharmacy, Rowland's pharmacy, Superdrug and independent pharmacies in Oxford).

Registry lists of pharmacies were checked to make sure all Oxford pharmacies were sampled. Oxford hospitals were also visited to search for outpatient pharmacies (John Radcliffe Hospital, Churchill Hospital and Nuffield Orthopaedic centre).

A total of 28 pharmacies and 11 major retailers (Tesco, Sainsbury's, Co-Op and Waitrose) were visited as well as shops such as Toys R Us and Marks & Spencer (see establishments by location Appendix 5.1).

In the case that no newer devices were available during a search in a pharmacy or other establishment, three further searches were undertaken in other pharmacies and/or establishments. All outlets were visited repeatedly until no new devices were found for purchase. A total of 33 thermometers were collected in this manner (each type was purchased only once), in February 2013.

Furthermore, all main shopping centre and pharmacy websites where thermometers were purchased were searched. A total of 15 thermometers were found from Tesco's (3), Sainsbury's (3), Boots' (4), Lloyd's pharmacy (1), Rowland pharmacy (1) and Co-op's (3) websites. All 15 thermometers were ordered from which 9 were obtained (the remaining 6 were ordered and obtained from amazon.co.uk).

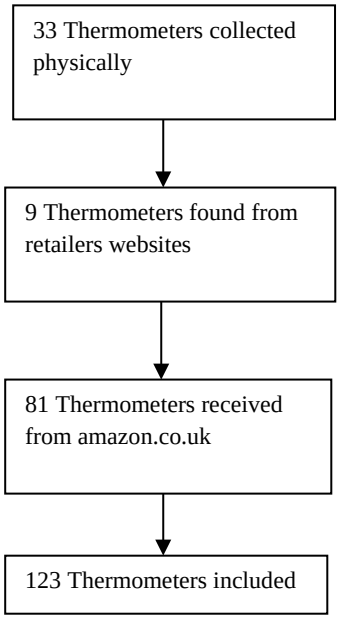
Finally, to incorporate the greatest number of thermometer that parents, carers and users in the United Kingdom could potentially buy, the site amazon.co.uk was also used.

New thermometers not previously found in pharmacies, main shopping centres or pharmacies websites were purchased online from amazon.co.uk. The thermometers purchased were advertised as being used for children or all age groups.

In total 70 thermometers were ordered in February 2013, and those not arriving at the department of Primary Care, were re-ordered three weeks later: 14 extra thermometers were found and ordered in later searches from amazon.co.uk in March 2013, 11 arrived (two were repeated). This meant a total number of 81 new thermometers were collected in total through the website and included.

Overall, from shops and the web, a total number of 123 different thermometers were included in this study (see flow chart search, Figure 5.1).

Figure 5.1 – Flow Chart Search showing the search for thermometers



5.4.3 Quality assurance of data extraction

The author identified the variables which were then extracted by the author and later checked by another researcher (BN) from the department of Primary Health Care Sciences at the University of Oxford. To ensure that data was correctly extracted, this was performed as

follows: the author unwrapped each thermometer and then recorded in excel the information; all the thermometer information (leaflet and packaging) was then scanned; a second researcher (BN) used both the scanned information and the thermometers to verify the extracted information by the author. Where any doubts were raised, consensus by both researchers was reached by revisiting the specific thermometer information.

5.4.4 Data extraction

To facilitate data extraction and analysis, data obtained from thermometer packaging and leaflets were divided into different categories and subdivided as: A) basic features and details (6 features); B) usage (9 features); C) temperature ranges and fever thresholds (two features); and D) consistency with NICE feverish illness recommendation (13 features). These categories were summarised in table 5.1 to 5.3 and A.1 to A3.

From the 28 categories extracted, 15 were related to thermometer characteristics and general information, 13 related to advice from NICE in undertaking temperature and fever management. In addition, a section related to general information was also extracted. Data collection occurred first and once all data was obtained the analysis was undertaken.

Table 5.1 Basic features/details

Make	The manufacturer or trade name
Name of device	Thermometer name or denomination
CE Marked	Conformance with European Union regulations (yes/no answer)
Type of thermometer	Device type i.e. digital, forehead temporal, or chemical thermometers
Provides more than one type of measurement, please state	Which site/s provides measurement on
Cost	Device cost in pounds

Table 5.2 Usage

Includes information on the safety of use	Whether includes information on the safety use (yes/no answer)
More detail on safety information	Refers to safety information for children
Describes instructions on thermometer use	Yes/no answer
Where to place the thermometer	Mentions how to place the thermometer (yes/no answer)
How to leave it there	Describes in which manner to leave the thermometer for the measurement (yes/no answer)
How to read it	Describes the way in which the thermometer is read (yes/no answer)

Pictorial, no pictorial (has photos or pictures showing the measurement procedure or the site of measurement)	Whether it has photos, drawings or images showing how to place the thermometer in different body sites (yes/no answer)
How long to leave it for	Amount of minutes/seconds (yes/no answer)
Do they give any particular advice prior to measurement	Gives recommendation prior to using the thermometer and which ones these are (yes/no answer)

Table 5.3 Temperature ranges and fever thresholds

Normal temperature ranges specified	Includes temperature ranges considered normal in one or more body sites or by age and/or provides range/s (yes/no answer)
Specifies temperature thresholds considered to be a fever	Identifies temperature thresholds considered to be a fever by the device (yes/no answer)

Consistency with NICE feverish illness recommendation

A.1 – Fever definition

Is this the same as thresholds given by NICE	Whether the fever thresholds identified by the device are the same as the ones considered by NICE (yes/no answer)* *According to NICE[19] fever is "an elevation of the body temperature above the normal daily variation". For normal children, body temperature is based on a range (mean ± 2SD) temperatures at various sites: oral (33.2 - 38.2 °C), rectal (34.4 - 37.8 °C), tympanic (35.4 - 37.8 °C), axillary (35.6 - 37.2 °C) and forehead (35.6 - 37.9 °C)[28]. Moreover, the guideline[29] has defined a temperature ≥ 38 °C or higher as its inclusion criteria for fever.

A.2 – Sites and thermometer types

Does it recommend oral or rectal temperature measurements in children aged 0-5 years?	Recommends oral or rectal temperature measurements in children aged 0-5 (yes/no answer)* *According to the NICE[19] guideline in children aged 4 weeks to 5 years, the body temperature should be measured by one of the following methods: – Electronic thermometer in the axilla – Chemical dot thermometer in the axilla – Infra-red tympanic thermometer Children < 4 weeks should be measured with an electronic thermometer in the axilla**.**
Does it recommend that in children from 4 weeks to 5 years of age measurements should be done with a) Electronic thermometer in the axilla	Whether the device recommends children from 4 weeks to 5 years of age measurements should be done with an electronic thermometer in the axilla (yes/no answer)
b) Chemical dot thermometer in the axilla	Whether the device recommends children from 4 weeks to 5 years of age measurements should be done with a chemical dot thermometer in the axilla (yes/no answer)
c) Infra-red tympanic thermometer	Whether the device recommends children from 4 weeks to 5 years of age measurements should be done with an infra-red tympanic thermometer (yes/no answer)
Does it recommend the use of a forehead chemical thermometer	Whether the device recommends the use of a forehead chemical thermometer (yes/no answer)

A.3 – Fever management

Does it recommend parental or carer perception of fever to be considered valid and taken seriously by healthcare professionals	Enquiries if the parental or carer perception of fever to be considered valid and taken seriously by healthcare professionals (yes/no answer)
Does the leaflet provide any guideline on how to manage fever in a child?	Assesses provision of guideline on how to manage fever in a child (yes/no answer) and descriptive explanation provided
a) What clinical features to assess in a child who has a fever	Assesses clinical features in a child who has a fever and describes which ones these are (yes/no answer)

b) When to seek advice from a healthcare professional	Advises when to seek advice from a healthcare professional and describes explanation provided (yes/no answer)
c) Treatment to use for a febrile child	Advises treatment to use for a febrile child and gives explanation provided (yes/no answer)
d) Refers to the NICE guideline, patient.co.uk or other official site information	Refers to the NICE guideline or any other official information site (e.g. patient.co.uk) (yes/no answer)
14 - Any other information	Describes any other information that may have some importance and that has not been covered in other points

5.4.5 Data analysis

As shown in the preceding tables data that was extracted related to specific thermometer features and advice from the NICE guideline. Data was divided in terms of categorical (nominal and ordinal) and numerical (discrete data) variables.[30] Descriptive statistics were used to analyse all variables extracted from the data, mathematical summaries were used to describe the data. Microsoft Excel 2010 was used to analyse all variables. This included analysis of the relationship between cost and the following thermometer information: comparison of temperature thresholds obtained with thresholds given by the NICE guideline, treatment for a febrile child, clinical features to assess in a child who has a fever, when to seek advice from a healthcare professional. SPSS statistics 19 was used to understand the relationship between thermometer cost and the information they provided.

Thermometer features

The proportion of thermometer brands and unidentified brands in the thermometer sample was represented as a percentage, which was also used to understand how many thermometers were CE marked, and how many thermometers per type were found. Thermometers were classified into 6 main types: digital electronic thermometer, forehead thermometer, infrared ear and forehead thermometer, infrared non-contact thermometer, mercury free thermometer and pacifier thermometer.

Devices stated one or more sites to measure temperature. Five different main sites and multiple sites were considered, and the percentages from the total amount of thermometers per body site were obtained. The body sites considered were the following: Axilla, ear, forehead, oral, rectal and multiple sites (axillary and oral, axillary and rectal, oral and rectal, ear and forehead and forehead and ear lobe).

Cost

The information was sought to understand whether thermometer price was related to provision of information on fever care according to the NICE guideline.

The number of devices was calculated according to each cost category. Approximate thermometer cost was extracted in the following values: (< £5, between £5 to < £10, between £10 to < £20, between £20 to < £30 and ≥ £30); median, arithmetic mean and standard deviation were calculated.

Thermometer cost was compared with: 1) thermometer's information on acknowledging fever as body temperature of ≥ 38 °C or higher (according to NICE guideline); 2) information that devices provided on clinical features to assess a child with a fever as suggested by the NICE traffic lights (colour, activity, respiration, hydration); 3) information from devices that suggested when to seek advice from a healthcare professional and whether these indications had any relation to NICE recommendations for carers; and 4) treatment recommendations were searched for within thermometer information and compared with indications for home care by NICE. A binary scale was used for the presence or absence of this information, so a higher cumulative score (range 0-4) indicated higher compliance. For example, a thermometer containing no information mentioning the above will have a zero score. Spearman's rank correlation coefficient was used to understand if there was a relationship

between thermometer price and their subsequent score from their thermometer information using SPSS statistics 19.

Safety information

Safety information was considered from the following perspectives and analysed in percentages: how to store the thermometers away from children; avoidance of unsupervised use by children; avoidance of swallowing of the device by children; avoidance of its use when detrimental towards the child's health; prevent attaching any foreign object to the thermometer; do not dip in substances before its use on the child; other precautions.

Information about thermometer use

Provision of information about how to use the thermometer was classified as follows and analysed in percentages: body site to place the thermometer; how to use the thermometer; how the thermometer should be left in the site; how to read the temperature; the provision of pictorial information; how to place the thermometer in different body sites

Time to leave the thermometer in the body site

The recommended time to leave the thermometer in the body was classified in ranges, suggested measuring times in devices were varied, ranging from a few seconds to over a minute. The percentage of thermometers that measure temperature within these time ranges was calculated. Furthermore, percentages of both thermometers that did not specify the measurement time in every body site, and, the ones that did were examined. The author used his judgement to produce the following time ranges: 0 sec to 10 sec; 10 sec to 20 sec; 20 sec to 30 sec; 30 sec to 1 min; ≥ 1 min to 5 min; ≥ 5 min.

The percentage was also calculated for the proportion of devices that recommended a device dwell time for all the body sites appropriate for the device.

Advice on conditions prior to obtaining a measurement

The percentage of thermometers that gave advice about preparation prior taking a measurement was calculated. Advice was further divided in terms of avoidance of certain activities and length of time specified prior to measurement.

Information about normal body temperature and fever

Percentages were calculated for the proportion of thermometers that cited a normal body temperature at a specific body site or several sites.

NICE related advice

Information about temperatures considered to be diagnostic of fever from thermometer leaflets was extracted. These temperatures were then compared to those specified by the NICE guideline[29] as a fever (equal to or above 38 °C). Percentages were calculated to quantify conformance with NICE guideline.

Data was also extracted about advice contained within thermometer information material including coverage of NICE guideline advice, regarding: use of different types of thermometers; advice to take into account parental and carer perception of illness; fever management strategies in a child with a fever.

Use of different types of thermometers

The following data were obtained on consistency of thermometer type with NICE recommendations, including: number and percentage that recommended oral or rectal measurement at all ages; number and percentage that recommended oral or rectal measurement in children above 4 or under 4 years of age. Number and percentages of the following thermometers were also estimated: electronic thermometer in the axilla; chemical dot thermometer in the axilla; infra-red tympanic; forehead chemical thermometer.

Advice to take into account parental and carer perception of illness

Suggestions were identified from thermometer information on parental and carer perception of illness. These included information advising users to consider their own perceptions (i.e. where in doubt consult with a doctor), or to consider their own perception of illness, as well as the actual temperature shown on the thermometer. The number of thermometers that provided the above advice were extracted and percentages were obtained.

Management strategies in a child with a fever

Thermometer information was searched in order to extract any management strategies for the care of fever. This included information on when to seek advice from a healthcare professional, advice on the management of abnormal or prolonged high temperature, and suggesting where to ask for advice when the thermometer's users were not sure how to interpret a measurement. Advice on management of fever was extracted including cooling strategies (e.g. removing clothing and keeping a cooler room temperature, baths, sponging or drinking fluids), or drug management such as administering antipyretic medication.

In addition, searches looked for any specific reference to the NICE or other evidence-based guidelines (see Table A3 variables extracted). Percentages were obtained from all the variables.

5.5 Results

5.5.1 Thermometer features

Of the 127 thermometers ordered 123 were obtained (97%). Devices were collected from mainstream pharmacies and shops in person (33, 27%), from mainstream pharmacies and shop's websites (9, 7.3%) and most were obtained from the website www.amazon.co.uk (81, 66%).

A total of 70 different manufacturers of thermometers were identified, a further four (3.2%) did not have an identified manufacturer. All thermometers but five (4%) were CE marked (see Box Non CE marked thermometers, Figure 5.2).

Figure 5.2 Box Non CE marked thermometers

Electronic digital thermometer (digital thermometer, no name stated)

Geratherm – Mercury–free oral thermometer (mercury–free thermometer)

Fever thermometer new 2011 – Fever thermometer (digital thermometer)

Vick paediatric – Baby thermometer (digital thermometer)

1st Aid solution – 1 Digital thermometer (digital thermometer)

Thermometers collected were divided into six main types of thermometer, these categories were mutually exclusive (see Table 5.4).

Table 5.4 – Types of thermometers

Types of thermometers	No.	%
Digital electronic thermometer* *Use an electrical resistance in a metal wire to measure temperature (axillary, rectal and oral use)	55	44.7
Infrared ear thermometer and forehead thermometer* *Contain an optical sensor which detects infrared emissions very rapidly from the tympanic membrane. Can be used either on the forehead or in the ear	31	25.2
Forehead chemical strip* *Composed of small of strips of plastic with cavities which contain a chemical dye that changes with graded temperature variations, use on the forehead	19	15.4
Infrared non-contact thermometer* *Detect infrared emissions very rapidly from outer surface from the skin of the forehead, measure does not need direct contact with the skin (two to three centimetres away)	10	8.1
Pacifier thermometer* *Silicone orthodontic thermometer with a plastic shield (baby nipple) and the pacifier that is placed in the baby's mouth	6	4.9
Mercury free thermometer* *Contain an expandable non-toxic liquid that changes slightly with temperature; the small change in volume drives the narrow liquid column a relatively long way up the thermometer tube identifying a specific temperature (axillary, rectal and oral use)	2	1.6

Almost half (45%) of all thermometers were digital, the second most common type was infrared ear thermometer and forehead thermometers (25%), followed by forehead (chemical strip) thermometers (15%). Devices were classified in 10 different types depending on which body site(s) the leaflets recommended use (see Table 5.5).

Table 5.5 – Body sites recommended for thermometer use

Body sites recommended for thermometer use	No.	%
Axillary, oral and rectal	42	34.1
Forehead	31	25.2
Ear and forehead	12	9.8
Ear	11	8.9
Axillary and oral	10	8.1
Oral	8	6.5
Axillary and forehead	3	2.4
Axillary and rectal	3	2.4
Forehead and ear lobe	2	1.6
Behind ear	1	0.8

The most commonly recommended body sites to be measured were axillary, oral and rectal (34%). This was followed by thermometers advising forehead measurements (25%) and ear

and forehead measurements (10%). Thermometers were also grouped depending on the number of different sites they measured: 1 site (49, 40%), 2 sites (32, 26%) or 3 sites (42, 34%).

Usage

Most thermometer leaflets included some safety instructions (109, 89%); these could be classified into 7 subcategories (see Table 5.6).

Table 5.6 – Safety information contained in thermometers leaflets

Safety information	No. of devices	%
1 Keep out (store away) from children	33	27
2 Do not allow children to use them/without supervision	33	27
3 Avoid children swallowing battery or other parts	21	17
4 Other safety precaution*	6	4.9
5 Never dip the device in sweet substances or medicine with regards to children under the age of 16 months	5	4.1
6 Do not attach ribbons as it may cause strangulation	3	2.4
7 Cease use if pain occurs, or in the presence of otitis, tympanitis, scarred skin or trauma	1	0.8

***** The oral method is not recommended for babies and very young children; do not allow the child to take its own temperature; basic safety precautions should always be observed specially when this product is used by, on or near children or invalids

The most common safety information regarded keeping devices out of reach of children (27%) or not allowing children to use them on their own (27%), as well as cautions about ingesting the battery or other parts (17%). One thermometer (Boots pharmaceutical digital thermometer) specifically advised to "never give aspirin to children under the age of 16 to reduce fever". However, 14 (11%) thermometers did not include safety information instructions and one (Bebeconfort dual thermometer) stated it was "completely safe for use in children".

Almost all leaflets described instructions on thermometer use (122, 99%). This included information on where to place the thermometer (120, 98%) which consisted of indicating the body site where to place the device and stepwise advise on how to do so (112, 83%). However, for some thermometer leaflets this advice was incomplete by not describing how to place the device (12, 10%). Most thermometers specified the time thermometers were

required to stay in situ to perform the measurement (93, 76%), but almost 1 in 5 thermometers did not (24, 20%). A small number of leaflets (6, 4%) did not specify a measuring time but provide statements such as ”a long beep will signal the end of measuring”, “just a few seconds” or “temperature is displayed immediately”.

The level of detail on thermometer advice varied between devices. Almost all thermometer leaflets indicated how to read the thermometer (112, 91%), description varied depending on the devices. Over half (72, 58%) of the devices contained photos, drawings or images showing how to place the thermometer in different body sites.

Almost half of the thermometer leaflets specified a single measuring time for a body site (52, 42%). Multiple body sites measurement times were given in some leaflets (41, 33%).

Measurement times shown in thermometer leaflets varied widely, from a few seconds to minutes. Thermometers were distributed in 6 different groups (see Table 5.4). Digital electronic thermometers seemed to have the widest range of measuring time and were included in all the time range categories.

These thermometers were further divided into six groups (see Table 5.7) depending on how long it was suggested to leave the device in situ, with the greatest number of thermometers (digital electronic) requiring between 1 to 5 minutes to measure temperature (21, 17%). For forehead thermometers, classified in three groups (0 sec - 10 sec, 10 sec - 20 sec and 30 sec - 1 min), the most recommended time to do a measurement was 10 to 20 seconds (16, 13%). Different types of infrared thermometers were sub-grouped in up to three groups (0 sec - 10 sec, 20 sec- 30 sec and ≥ 5 min), and the most frequent time of measurement recommended was 0 to 10 seconds (18, 15%). Pacifier thermometers were divided into two groups (≥ 1 - 5 min and ≥ 5 min) with an equal number of thermometers in each group (2, 1.6%). Mercury

free thermometers was the final type of thermometer analysed with two devices (1.6%) suggesting 1 to 5 minutes to measure temperature (see Table 5.7).

Table 5.7 – How long to leave the device in place to take a measurement

Type	Time	No. devices	%
Digital electronic thermometer	≥ 1 - 5 min	21	17.1
	≥ 5 min	7	5.7
	20 sec - 30 sec	6	4.9
	10 sec - 20 sec	5	4.1
	30 sec - 1 min	4	3.3
	0 sec – 10 sec	4	3.3
Forehead chemical strip thermometer	10 sec - 20 sec	16	13.0
	30 sec - 1 min	1	0.8
	0 sec - 10 sec	1	0.8
Infrared ear thermometer and forehead thermometer	0 sec - 10 sec	18	14.6
Infrared non-contact thermometer	0 sec - 10 sec	2	1.6
Infrared non-contact thermometer	≥ 5 min	1	0.8
Infrared ear thermometer and forehead thermometer	20 sec - 30 sec	1	0.8
Mercury free thermometer	≥ 1 - 5 min	2	1.6
Pacifier thermometer	≥ 1 - 5 min	2	1.6
Pacifier thermometer	≥ 5 min	2	1.6

Thermometer advice prior to measurement

Half of the thermometers included advice about action or precaution recommended prior to measurement (67, 55%). Often thermometer leaflets specified statements such as not to take the temperature after exposure to very hot or cold conditions or after eating, drinking and/or exercising. Some thermometer information advised to lie or sit down before taking a measurement or not to take it shortly after waking up. Different devices provided different waiting times prior to taking a measurement on the above conditions which could be classified into 7 different subgroups: (1) avoidance of eating, (2) avoidance of drinking, (3) avoidance of exercise, (4) avoidance of showering for (a) 20 minutes (26, 21%), (b) between 10 to 20 minutes (5, 4%), (c) between one to five minutes (4, 3%), or (d) without providing a time (9, 7%). Other advice provided prior measurement consisted of (5) appropriate cleaning of the body site prior to device placement (12, 10%), (6) allowing the body to accustom to a new temperature if coming from different environmental conditions (3, 2%), or (7) grouped

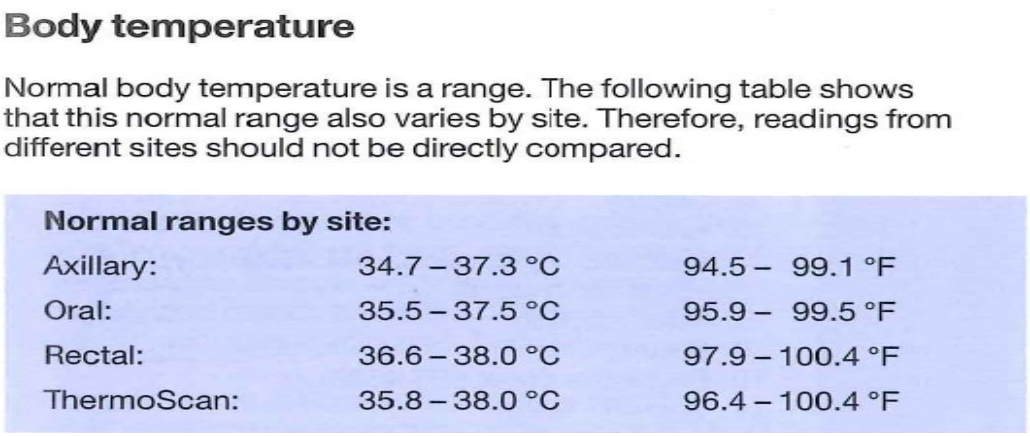
as other advice (including a variety of aspects such as take temperature after waking up or avoiding drinking cold beverages before measurement) (8, 7%).

Thresholds

Information about normal body temperature and fever thresholds

The majority of devices (79, 64%) did not provide information on normal body temperatures. Thermometers that did (44, 36%) attempted to provide users with common body temperatures in normal conditions. Nevertheless, leaflets provided different descriptions of what a normal temperature is. Some leaflets gave a single figure as a normal temperature in one or more sites (7, 6%)*, some leaflets gave a range of temperature per age (3, 2%)*2, some provided a normal temperature range of temperature per age and site (8, 7%)*3 and other leaflets gave a range of temperature per site (8, 7%)*4 (see example in Figure 5.3 Braun ThermoScan 5). However, most thermometer leaflets that supplied a normal temperature range did not provide the normal body temperature in all suggested body sites (18, 15%) i.e. if the thermometer was recommended for axillary, rectal and oral measurement it would provide a normal body temperature for one or two sites instead of all three.

Figure 5.3 – Picture of Braun ThermoScan 5



Body temperature

Normal body temperature is a range. The following table shows that this normal range also varies by site. Therefore, readings from different sites should not be directly compared.

Normal ranges by site:		
Axillary:	34.7 – 37.3 °C	94.5 – 99.1 °F
Oral:	35.5 – 37.5 °C	95.9 – 99.5 °F
Rectal:	36.6 – 38.0 °C	97.9 – 100.4 °F
ThermoScan:	35.8 – 38.0 °C	96.4 – 100.4 °F

* i.e. 37°C

* 2 i.e. 0 to 2 years 36.4 to 38 °C; 3 to 10 years 36.1 to 37.8 °C; 11 to 65 35.9 to 37.6 °C; > 65 years 35.8 to 37.5 °C;

*3 i.e. 0 to 2 years 36.4 to 38.0 °C; 3 to 10 years 36.1 to 37.8 °C; 11 to 65 years 35.9 to 37.6 °C; > 65 35.8 to 37.5 °C;

By measuring method rectal 36.6 to 38 °C; Oral 35.5. to 37.5 °C; Axillary 34.7 to 37.3 °C; Ear 35.8 to 38 °C;

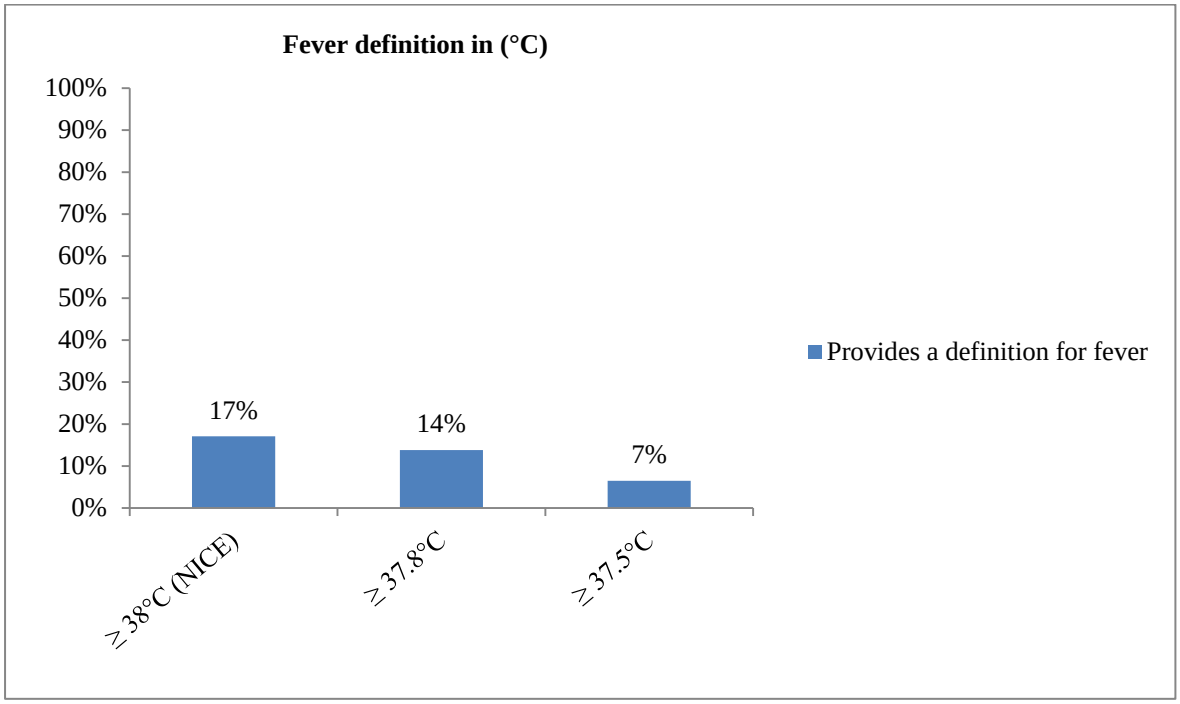
*4 i.e. Rectal 36.6 to 38 °C; Oral 35.5 to 37.5 °C; Axillary 34.7 to 37.3 °C

5.5.2 Comparison with NICE advice on thermometer use

Fever definition

Fewer than half of all leaflets (49, 38%) provided a definition of fever, and these did not always match the NICE[19] guideline. The most common temperature thresholds cited as fever were equal or above 37.5 °C (8, 7%), equal or above 37.8 °C (17, 14%) and equal or above 38 °C (21, 17%) (see Figure 5.4). Furthermore, some thermometers provided fever definitions by age range (adults and children) (1, 0.8%) or by colour range with red colour being a fever, orange an elevated temperature and green the absence of fever (4, 3%); however, these colours were not assigned with any specific temperature values. Finally, thermometer leaflets that considered other body temperatures as fever (different to the ones mentioned above) were grouped as other (2, 1.6%) i.e. 37.6 °C or above.

Figure 5.4 – Main fever definitions in thermometer (°C)



Definition of fever from the majority of the thermometers did not follow NICE guideline advice[29], less than one quarter of thermometers specified fever as equal or above 38 °C (17, 14%), however, a small percentage of thermometers (4, 3.2%) complied with NICE definition of fever by having an alarm default at 38 °C.

Table 5.8 describes the conformity of thermometer information with the NICE guideline regarding: definition of fever, types of thermometers found, description of clinical features to assess a child who has a fever, suggested management at home and when to seek for further help (see Table 5.8).

Table 5.8 – NICE guidance and compliance from thermometer information

NICE Guidance	Compliant theme
Definition of fever ≥ 38 °C	- 21 (17%) devices in the study defined fever as 38 °C
Thermometer type - Infants under the age of 4 weeks measured with an electronic thermometer in the axilla - Children from 4 weeks to 5 years measured with an electronic or chemical dot thermometer in the axilla, or with an infrared thermometer in the ear	- 54 (44%) leaflets recommended the use of axillary measurements* - 1 (0.8%) leaflet recommended the use of a chemical thermometer in the axilla* - 24 (19.5%) leaflets recommended the use of infra-red tympanic thermometers* *Thermometer information did not specify age ranges for the use of the devices
Description of clinical features to assess a child who has a fever - Colour of skin - Activity - Respiratory rate - Hydration - Low capillary refill - Heart rate - Fever (≥ 38 °C children under 3 months, ≥ 39 °C children under 3 to 6 months, fever lasting more than 5 days)	- 11 (9%) leaflets suggested abnormal temperature - 7 (3%) leaflets suggested agitation, severe sweating, flushed skin, fast pulse rate
Management at home - Offer child regular drinks - Detect signs of dehydration - Encourage the child to drink more fluids and consider seeking further advice if signs of dehydration are detected - Identify a non-blanching rash - Check the child during the night - Keep the child away from nursery or school if fever persist - Antipyretic intervention can be used	- 3 (2.4%) leaflets suggested drinking liquids - 1 (0.8%) leaflet suggested administering antipyretics
When to seek further help - The child has a fit - The child develops a non-blanching rash - The parent or carer feels the child is less well (or is more worried) that when they previously sought advice - The fever lasts longer than 5 days The parent or carer is concerned or distressed that they are unable to look after their child	- 20 (16%) leaflets recommended to seek advice when abnormal/increased/or prolonged increased temperature - 16 (13%) leaflets recommended to seek advice when having uncertainty while interpreting the results

Subjective detection of fever by parents was considered as valid by 19 (16%) leaflets, however, contrary to NICE guidance two (1.6%) leaflets explicitly had indications against it: "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". Only two thermometer leaflets (1.6%) referenced to the medical literature, however, not a single leaflet mentioned NICE guidance or a relevant website such as patient.co.uk.

Thermometer price in relation to advice provided

Thermometer cost varied widely, device price ranged from less than £5 (44, 36%), between £5 and less than £10 (27, 22%), between £10 and less than £20 (22, 18%), between £20 and less than £30 (15, 12%) and £30 or more (15, 12%). Most thermometers cost under £30 (108, 88%). The standard deviation (£13.6) was calculated to understand the amount of price variation in devices from the average thermometer price. Median and mean of the thermometer cost were £14.2 and £13.8 respectively.

Thermometer cost was compared with advice provided by thermometer information. This advice was divided in four groups:

a) Thermometer information that provided temperature thresholds equal to or above to 38 °C as a fever, which is the temperature threshold suggested as fever by the by the NICE guideline, were given a score of one.

b) Advice provided by leaflets related to clinical features to assess a child with fever was looked at in thermometer information from devices. Suggested features that prompted to visit further care were abnormal temperatures, severe sweating, flushed skin, or fast pulse rate. These leaflets were given a score of one.

c) Devices that suggested when to seek advice from a healthcare professional were also given a score of one.

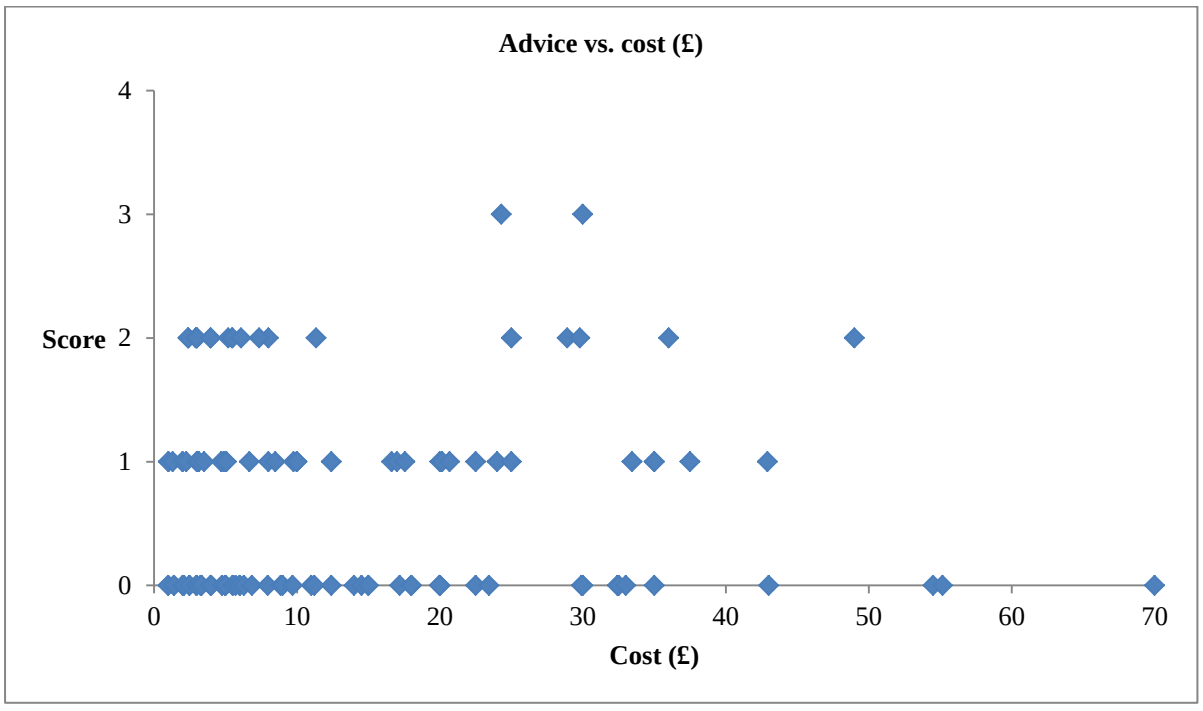
d) Devices that provided advice which treatment to use for a febrile child were given a score of one.

If the thermometer information complied with any of the four groups a score of one was assigned, a greater score corresponded to a higher compliance with NICE advice. A continuous scale based on the thermometer price (£0.99 to £69.99) was assigned to the scores

and plotted. An example of the requirements to obtain a score of 3 would be a device that suggested clinical features to assess, when to seek advice from a healthcare professional as well as a type of treatment to use for a febrile child. For devices that had a score between 1 to 4 see Appendix 5.2.

There was no difference in the quality of information received between lower and higher cost thermometers (see Figure 5.5). A high number of cheaper thermometers included the standard caution "to consult a GP in the case of doubt". Furthermore, no significant association at conventional $p < 0.05$ was found between thermometer cost (£0.99 to £69.99) and the presence of the four evidence statements above mentioned ($p = - 0.072$).

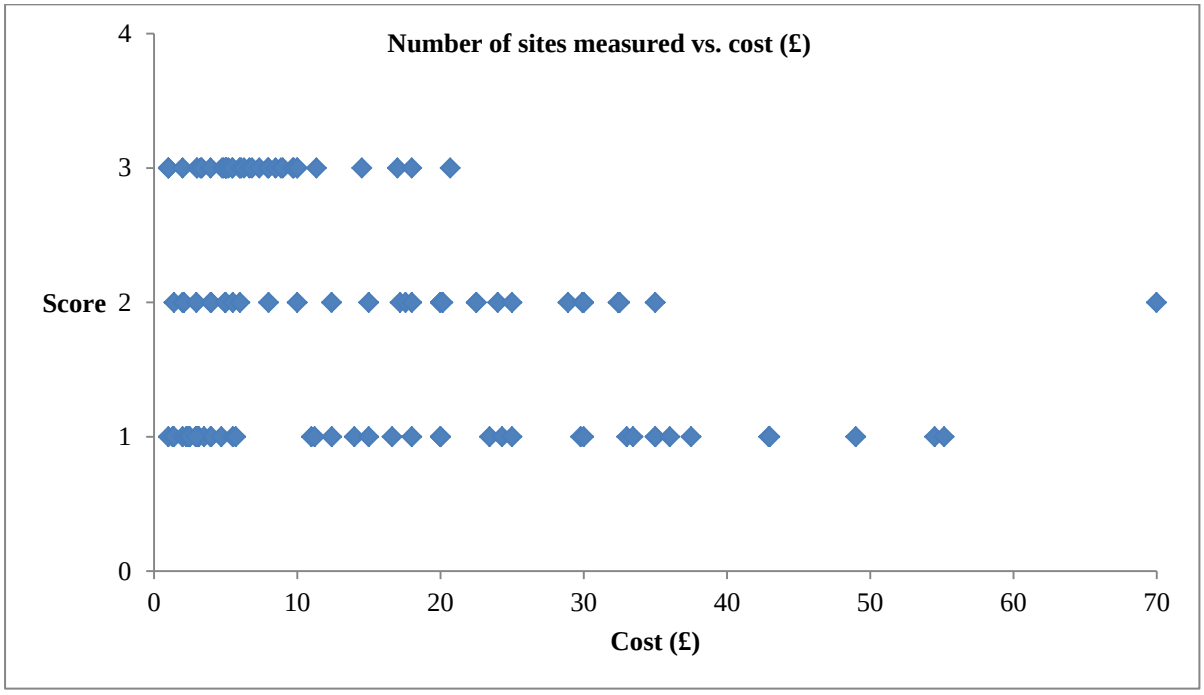
Figure 5.5 – Advice vs. cost (£)



Thermometer cost and its association with the numbers of sites suggested were compared. Figure 5.6 shows a continuous scale based on the thermometer price (£0.99 to £69.99) assigned to the scores and plotted. A measured site corresponded to a score of one, a greater score corresponded to a higher number of body sites measured.

Lower price thermometers seemed to measure temperature in a greater number of sites. This may be due to an increased number of digital thermometers with up to three suggested body sites per measurement (oral, axillary and rectal). The most expensive thermometers measured one and in some cases two body sites, as infrared devices could be used at the eardrum and/or the forehead.

Figure 5.6 – Number of sites measured vs. cost (£)



5.6 Discussion

Thermometers are readily available in pharmacies, shops and can be ordered online. There are varieties of devices that can be used in different body sites, which can be applied using different techniques in the same sites (e.g. temporal, non-contact forehead thermometers or normal contact infrared thermometers) or a single type of thermometer can be used at different body sites e.g. digital electronic thermometers.

The array of devices together with seemingly conflicting information may compromise correct use by parents and carers and subsequent fever management in children.

5.6.1 Clarity of the information presented

Thermometer information was very heterogeneous in the manner that instructions and advice were presented, the amount of data they contained and its detail of explanation.

In some instances accompanying information was insufficient to understand the correct use of the device. This information described briefly the contents of the thermometers and provided basic information regarding safety of use (e.g. SpongeBob Squarepants digital electronic thermometer, Mr Sneeze forehead thermometer, Summer forehead strips etc…). Devices sometimes provided meagre detail about how to use the thermometer or about technical features.

Thermometers leaflets often contained unclear or incomplete statements. For example, one thermometer stated 10 seconds measuring time on the package, however, within its leaflet stated 10 minutes of measuring time. Another thermometer mentioned “30 seconds to a minute” or “just a few seconds”. In some instances the device appeared to be sold solely as a mere measuring device and provided little information about fever and its care.

Leaflet design, its length and the information contained varied greatly from device to device. Some thermometers did not include leaflets, i.e. all the information was incorporated on the packaging and therefore was possibly at greater or lesser risk of being discarded; whereas in other leaflet’s information was a detailed booklet. Some of the most expensive thermometers included long booklets, however, the bulk of this was translation into several languages. Much of the information provided was related to technical characteristics and features of the devices rather than advice on fever management or temperature taking.

5.6.2 Fever definition, thermometer accuracy and body temperature in thermometers

Fever is a common medical sign characterised by an elevation of temperature above the normal range of 36.5 to 37.5 °C, and temperature should be thought as a range rather than a specific value.[28] According to NICE[19 20] fever is "an elevation of the body temperature above the normal daily variation". However, fever thresholds were mentioned in less than half of the leaflets and packaging. Few thermometers specified a fever as a temperature equal or above to 38 °C. Many thermometers provided other specific definitions of fever mainly as a single figure or an incomplete range of temperatures per site (thermometers did not specify what the fever threshold was in every single site).

Some leaflets mentioned thermometer types that measured temperatures more accurately. Thus some chemical forehead thermometers recognised that the device had a lower accuracy than digital electronic devices, and in some cases advised a second measure with a digital electronic thermometer if there was doubt with regards to the existence of fever. More than half (53%) of the thermometers did suggest the use of non-recommended sites such as oral and rectal measurements.

Thermometer information did not generally mention the accuracy of thermometers purchased compared to other types of thermometers but only their working temperature range i.e. 15.5 to 40 °C. No discrepancies were raised even in leaflets of devices from which relatively low literature pertaining evidence to accuracy existed e.g. pacifiers or temporal thermometers[31-33] or thermometers such as forehead chemical strips where low clinical accuracy has been suggested.[34-36]

Normal body temperature

Most leaflets did not provide information about normal body temperature; either a single site or several sites were defined by a single temperature or as temperature ranges according to age or site.

For normal children, body temperature falls within a range of temperatures at various sites: oral (33.2 - 38.2 °C), rectal (34.4 - 37.8 °C), tympanic (35.4 - 37.8 °C), axillary (35.6 - 37.2 ° C) and forehead (35.6 - 37.9 °C)[28]. These values were obtained from a systematic review of vital signs summarising results from 27 studies.[37] However, normal body temperature mentioned by device's leaflets did not reflect current evidence.[37]

5.6.3 Fever management considerations, price and relation to advice

Over a third of thermometer leaflets mentioned seeking healthcare advice. Suggested directives were quite diverse and sometimes unspecific. Statements such as "in case of no temperature reduction consult your doctor", "if fever is present check with a GP", "If the temperature goes over 39 °C or remains above the normal for more than 2 days seek medical advice" were usual. Advice on "persistent fever, particularly in children, has to be treated by a doctor" was also common.

A minority of thermometers included provision of some sort of management information. Such information was mainly related to cooling conditions for the child: techniques not recommended by NICE guidance[19] such as sponging were sometimes mentioned. Only one thermometer suggested the use of antipyretic medication and not one single device mentioned NICE guidance.

In addition, more expensive thermometers did not seem to provide more or superior information about when to seek advice from a healthcare professional, what to do when a child was febrile or what clinical features to assess when fever is suspected.

5.6.4 Implications for further research

This study has looked at thermometers that can be purchased in mainstream shops, their websites and via the internet at www.amazon.co.uk. Future internet searches aiming at incorporating all other available thermometers may further inform current NICE guidelines and could enhance the reach and accuracy of the study findings.

An important aspect, not undertaken by this study, would be determining the accuracy of the collected thermometers. The Medicines and Healthcare Products regulatory Agency (MHRA)[18] in 2005 reported about the accuracy of available thermometers in the UK. Recent research has also looked at the accuracy of newer devices.[33] A further study could include analysing accuracy of all collected thermometers and whether thermometers available on the market could provide parents and carers with a reliable body temperature measurement.

Data from previous studies seemed to support the notion that performing physical activities such as exercise[24] or wearing extra clothing[38] may have an effect on body temperature. However, no conclusive evidence was found relating the consumption of food and beverages to body temperature, neither smoking,[39] as activities mentioned by some devices to avoid prior body measurements. Further research could clarify other factors which may influence body temperature at specific body sites, e.g. oral.

5.6.5 Limitations

Thermometer leaflets and packaging were very heterogeneous in their structure, both in the information contained in the leaflets and packaging, and the depth of their contents. The author tried to summarise data obtained from the thermometer leaflets to the best of his ability and a second researcher (BN) also checked through the data.

Whether thermometer leaflets had photos or pictures of the measurement site or how to perform the measurement was another variable taken into account for this study. On occasions, this representation was not very clear, and had to be interpreted by both researchers, and ultimately by the author whether to accept this information as being valid or not.

Sampling error may have occurred by including thermometers found only by one researcher alone. Thermometers were collected from mainstream pharmacies and shops physically, from mainstream pharmacies' and shops' websites and the remaining ones were obtained from one website.

Costs were based on the price that was paid for thermometers within the present study. Considering that pharmacies were sampled first, this could have an impact on costs as they may sell thermometers at a higher price than supermarkets or online stores. Prices of the same devices found on different websites could also be different.

The inclusion of more establishments in other cities and the use of different websites may increase the validity of this study. However, the large number of thermometers obtained means the results are likely to be generalizable at least to the UK.

5.6.6 Conclusion

Advice from information leaflets with thermometers given to parents and carers to seek medical or healthcare advice often seemed vague, i.e. "always consult your physician if you have a fever", "if you have a fever or high temperature seek advice from your pharmacist", "if you have health concerns seek medical advice".

Most of the thermometer information did not include guidance on fever management or thermometer use. Moreover, advice from NICE guidance for feverish illness in children or

any other evidence-based guideline was not mentioned. Few thermometers took into account parental and carer interpretation of fever and disease and some actually dismissed it.

Parents and carers should be informed of basic features of thermometer use (how to use it, site/s of use and safety of application of the device) as well as some basic advice about fever management.

The author of this study recommends companies producing thermometers to include a basic additional leaflet (or table included within their current leaflet). This information may include basic advice and the recommendations from an accepted clinical guideline. Such a leaflet could have a substantial impact on parents' and carers' understanding of fever management and could be easily developed, implemented and incorporated into legislation.

5.7 References

1. Allen LaPointe N, Pappas P, Deverka P, Anstrom K. Patient Receipt and Understanding of Written Information Provided with Isotretinoin and Estrogen Prescriptions. *Journal of General Internal Medicine* 2007;22(1):98-101.
2. McDonald-Miszczak L, Neupert SD, Gutman G. Younger-Old and Older-Old Adults' Recall of Medication Instructions. *Canadian Journal on Aging/La Revue canadienne du vieillissement* 2005;24(04):409-17.
3. Towney C. An analysis of patient information leaflets supplied with medicines sold by pharmacists in the United Kingdom. *Library and Information Research* 2001;25(80).
4. Fuchs J HM, Schaefer M. Analysis of German package inserts. *Int J Clin*

Pharmacol Ther. 2006 44(1).
5. Smith H GS, Brown R, Frew R. Evaluation of readability and accuracy of information leaflets in general practice for patients with asthma. *British Medical Journal* 1998;317(7153):264–65.
6. Fuchs J, Hippius M. Inappropriate dosage instructions in package inserts. *Patient Education and Counseling* 2007;67(1–2):157-68.
7. Haw C, Stubbs J. Patient information leaflets for antidepressants: are patients getting the information they need? *J Affect Disord.* 2011;128(1-2):165-70. doi: 10.1016/j.jad.2010.06.034. Epub 10 Jul 24.
8. Bernardini C, Ambrogi V, Perioli LC, Tiralti MC, Fardella G. Comprehesibility of the package leaflets of all medicinal products for human use: A questionnaire survey about the use of symbols and pictograms. *Pharmacological Research* 2000;41(6):679-88.

9. Nathan JP, Zerilli T, Cicero LA, Rosenberg JM. Patients' Use and Perception of Medication Information Leaflets. *The Annals of Pharmacotherapy* 2007;41(5):777-82.
10. Gröber-Grätz D WU, Knaus W, Gulich M, Zeitler HP. atient receipt and understanding of written information provided with isotretinoin and estrogenprescriptions. *J Gen Intern Med.* 2012;22(1).

11. Vander Stichele RH, De Potter B, Vyncke P, Bogaert MG. Attitude of physicians toward patient package inserts for medication information in Belgium. *Patient Education and Counseling* 1996;28(1):5-13.
12. Fioretti F, La Vecchia C, Tavani A, Parazzini F. Package inserts of oral contraceptives in Italy. *Pharmacoepidemiol Drug Saf.* 1996;5(5):315-9.
13. McDonough B, Kelly C. Patient information on nebulised antibiotics. *Nurs Times.* 2012;108(17):12-4.
14. Goodyer L, Savage I, Dikmen Z. Inhaler technique in Turkish people with poor English: a case of information discrimination? *Pharm World Sci.* 2006;28(2):107-14. Epub 2006 Jul 4.
15. Edwards ES, Edwards ET, Gunn R, Patterson P, North R. Design validation and labeling comprehension study for a new epinephrine autoinjector. *Ann Allergy Asthma Immunol.* 2013;110(3):189-93.e1. doi: 10.1016/j.anai.2012.12.008. Epub 13 Jan 11.
16. McGuire L, Millar K, Lindsay S. A treatment trial of an information package to help patients accept new dentures. *Behav Res Ther.* 2007;45(8):1941-8. Epub 2006 Nov 9.
17. Savage I, Goodyer L. Providing information on metered dose inhaler technique: is multimedia as effective as print? *Fam Pract.* 2003;20(5):552-7.
18. D Crawford Ng, S Wetworth. Thermometer review: UK market survey. 2005.
19. NICE. Feverish illness in children: Assessment and initial managemetn in children younger than 5 years. In: Press R, editor. *London*, 2007.
20. NICE. Feverish illness in children: Assessment and initial management in children younger than 5 years (guidance), 2013.
21. Schmitt BD. Fever phobia. Misconceptions of parents about fevers. *American Journal of Diseases of Children* 1980;134 (2):176-81.
22. Crocetti M, Moghbeli N, Serwint J. Fever phobia revisited: Have parental misconceptions about fever changed in 20 years? *Pediatrics* 2001;107 (6):1241-46.

23. Crocetti M, Sabath B, Cranmer L, Gubser S, Dooley D. Knowledge and management of fever among Latino parents. *Clin Pediatr (Phila)* 2009;48(2):183-9.
24. Sakai R, Okumura A, Marui E, Niijima S, Shimizu T. Does fever phobia cross borders? The case of Japan. *Pediatrics International* 2011:no-no.
25. O'Neill-Murphy K, Liebman M, Barnsteiner JH. Fever education: does it reduce parent fever anxiety? *Pediatr Emerg Care* 2001;17(1):47-51.
26. Broome ME, Dokken DL, Broome CD, Woodring B, Stegelman MF. A study of parent/grandparent education for managing a febrile illness using the CALM approach. *J Pediatr Health Care* 2003;17(4):176-83.
27. Sarrell M, Kahan E. Impact of a single-session education program on parental knowledge of and approach to childhood fever. *Patient Educ Couns* 2003;51(1):59-63.
28. Crawford DC, Hicks B, Thompson MJ. Which thermometer? Factors influencing best choice for intermittent clinical temperature assessment. *Journal of Medical Engineering & Technology* 2006;30(4):199-211.
29. NICE. Assessment and initial management of feverish illness in children younger than 5 year. *BMJ* 2007;334(7604): 1163–1164.
30. Clarke S. Use Of Thermometers In General Practice. *BMJ: British Medical Journal* 1992;304(6832):961-63.
31. Greenes DS, Fleisher GR. Accuracy of a Noninvasive Temporal Artery Thermometer for Use in Infants. *Arch Pediatr Adolesc Med* 2001;155(3):376-81.
32. Callanan D. Detecting Fever in Young Infants: Reliability of Perceived, Pacifier, and Temporal Artery Temperatures in Infants Younger Than 3 Months of Age. *Pediatric emergency care* 2003;19(4):240-43.
33. Laird C CG, Davie A and Stevenson G What is the clinical and cost effectiveness of temporal artery thermometers compared with infrared in-ear thermometers for temperature measurement in routine practice. In: Scotland HI, editor, 2013.
34. Shann F, Mackenzie A. COmparison of rectal, axillary, and forehead temperatures. *Archives of Pediatrics & Adolescent Medicine* 1996;150(1):74-78.
35. Scholefield JH, Gerber MA, Dwyer P. Liquid crystal forehead temperature strips: A clinical appraisal. *American Journal of Diseases of Children* 1982;136(3):198-201.
36. Reisinger KS, Kao J, Grant DM. Inaccuracy of the Clinitemp Skin Thermometer. *Pediatrics* 1979;64(1):4-6.
37. Thompson M, Mayon -White R, Harden A, Perera R, McLeod D and Mant D. Using vital signs to assess children with acute infections: a survey of current practice. *British Journal of General Practice* 2008(58):236-41
38. Hirvonen EA, Niskanen M. Thermal suits as an alternative way to keep patients warm peri-operatively: a randomised trial. *Eur J Anaesthesiol.* 2011;28(5):376-81. doi: 10.1097/EJA.0b013e328340507d.
39. Terndrup TE, Allegra JR, Kealy JA. A comparison of oral, rectal, and tympanic membrane-derived temperature changes after ingestion of liquids and smoking. *The American Journal of Emergency Medicine* 1989;7(2):150-54.

Chapter 6 Assessment of parents' and carers' knowledge of temperature measurement and management of fever in children under five years: A survey

6.1 Introduction

As stated in the preceding chapters, fever is one of the most common reasons for parents to take their children to see a doctor.[1 2] A prospective cohort study of 13,617 pre-school children living in south-west England showed that fever together with respiratory and gastro-intestinal symptoms are common.[3] On most occasions children have self-limiting infections and recover without intervention. However, infection is a major cause of mortality in children between 0 to 5 years of age, with up to 1% for UK children having a serious infection such as meningitis, septicaemia, urinary tract infections and pneumonia.[4 5] A recent systematic review concluded that body temperature of 40 °C or more was a 'red flag' for serious infection, in settings with a low prevalence of serious infection.[6] It is therefore important to understand parents' and carers' skills and knowledge regarding measurement of temperature, fever interpretation and its subsequent management.

Body temperature knowledge and appropriate use of thermometers in children

Body temperature has been historically used by health professionals[7 8] and parents[9 10] to determine physical well-being. Lack of knowledge among parents, or anxiety about fever, may drive them to use services. For example, one study found re-consultations were common within the same episode of illness when fever persists.[11] Findings from Chapter 3 suggested that parents' understanding of what constitutes fever varied substantially,[12] and that some parents did not own a thermometer or know how to use one.[10 13 14]

Management of fever in children

Antipyretics are frequently used by parents to reduce fever.[15 16 17 18 19 20 19 20] Research has also highlighted that many parents attend the emergency department without having given children the recommended doses of paracetamol or ibuprofen.[19 21] Moreover, a trial in an emergency department concluded that a proportion of visits were a consequence of underdosing of paracetamol by parents,[19] and that these visits contributed to overcrowding. However, antipyretic overdosing may also occur.[22 14 20]

Studies have also shown parental use of non-recommended methods such as sponging with tepid water, alcohol rubs or cold water,[15 18 23 24] aspirin[25] or traditional methods is common place.[9 26]

Evidence within the UK about current parental or carer knowledge about temperature measurement or management in children is limited.[10 27] Only two UK questionnaire surveys of parental knowledge and perception of fever were identified in the published literature. These studies showed that the level of parental worries influenced the frequency with which they measured temperature and how aggressively they treated it. Non-recommended thermometers such as mercury-in-glass and crystal forehead thermometers were also used by parents to measure fever shown in one of these studies,[10] however this study was carried out in 1998.

6.2 Rationale for the study

Turkish and Italian surveys have shown a predominant use of electronic thermometers.[18 28] However, the current situation within the UK is uncertain. Furthermore, it is not known whether carers of children, in the UK, follow NICE guideline advice[1 29] and to the author's knowledge, there has been no UK based survey in a primary care setting.

The overall aim of the questionnaire was therefore to find out current parental and carer knowledge of temperature measurement and fever management in children 5 years or younger in the UK. A further aim was to comprehend where parents and carers obtain their information about fever and its care.

The hypothesis of this chapter is that parents and carers do not follow the NICE guideline recommendations to interpret temperature in a child, and do not always have sufficient knowledge to provide adequate care in the case of feverish illness. This hypothesis was investigated using a self-administered questionnaire.

6.2.1 Questionnaire objectives

- Assess parental and carer knowledge and management of fever and compare it to the NICE recommendations.
- Describe types of thermometers parents and carers use.
- Assess how parents and carers learn to read a thermometer.
- Assess parental and carer understanding of temperature measurements that require further care in infants 5 years or under in comparison to the NICE recommendations.
- Understand whether caring for more than one child can have an impact on knowledge about fever and its care.

6.3 Methods

This chapter used a self-administered questionnaire to explore the hypothesis that parents and carers may not always correctly measure temperature, understand what constitutes elevated body temperature for a child, and, have appropriate knowledge about fever and its management.

The questionnaire included three sections:

1) Section 1 included the following 6 socio-demographic questions: participant's date of birth, gender, number of children cared for, age of children, marital status and work situation.

2) Section 2 is the main body of the questionnaire. It was formed by 18 questions and divided in two subsections.

A) Questions one to 11 were adapted from a previously published questionnaire.[23] These questions examined participants' knowledge of what they considered to be a high fever, their worries about fever, harms from it and their fever management knowledge.

B) Questions 12 to 18 were developed by the author. These questions explored whether participants had a thermometer and what type of thermometer they owned. Ownership of devices that are no longer recommended such as mercury in glass thermometers,[30] or forehead strips to measure temperature[10] was examined. In addition, participants were asked whether they could recognise symptoms of feverish illness and care for them. These questions were developed based on previous knowledge about parental thermometer use,[10] questionnaires from previous studies[15 23 31-36] as well as NICE guidance on information for feverish illness.[1 29] The questionnaire included questions that assessed carers' understanding of different temperature threshold which made them think to take a baby 6 months or under further into care, and how they will further manage a fever.

The questionnaire was piloted on one parent, and then another five parents. Then three academic GPs reviewed it from a clinical point of view (MW, CH, MT) and a proficient English speaking person proofread the questionnaire. Furthermore, information from the piloted questionnaires was used to revise the questionnaire for this study. A second pilot study with 10 questionnaires was distributed, from which seven questionnaires were completed and returned. Two experts from the Centre of Evidence-Based Medicine revised it again (CH and MT). Each one of the different steps resulted in modifications before the final

version. A further version of the questionnaire added modifications based on suggestions of two assessors after a Transfer viva and experts from the Centre of Evidence-Based Medicine at the University of Oxford, with the later inclusion of questions related to the NICE leaflet for feverish illness in children less than 5 years for parents.

3) Section 3 offered participants the opportunity to add anything they felt that the questionnaire did not cover.

For the questionnaire, it was suggested that a minimum number of 271 questionnaires would be sufficient to sample parents and carers with children under five from different socio-economic backgrounds and different ethnic groups. This number was obtained based on the assumption that 50% of caregivers would not have a good understanding of temperature measurements and about the care of feverish illness in children younger than 5 years of age, with a confidence level of 90% and a ±5% of error. In order to obtain questionnaires completed from 271 parents and carers, it was estimated that up to 1000 parents and carers would need to read the Participant Information Sheet (PIS), assuming a response rate lower than 30%. A minimum of 300 participants for the survey questionnaire were later suggested by a Research Ethics Committee (Central & East).

The author conducted the survey after completing an MSc module on Introduction to Study Design and Research Methods as part of an MSc in Health Research. One focus group interview study ran alongside the questionnaire survey (see focus group interview in Chapter 4). Favourable research approval was granted for the questionnaire from the North Wales Research Ethics Committee (Central & East).

This study assessed parental and carer knowledge in relation to abnormal thresholds of body temperature, parental care of feverish illness in children, and signs and symptoms that need to

be identified for further care in children. It also examined the effect of having one or more children on parental knowledge or care of feverish illness.

Within this chapter the terms parent, participant, respondent, caregiver and carer will be used interchangeably. For the purpose of this chapter infant was defined as a child 6 months of age or less.

6.3.1 Participating practices

Two participating practices in Oxford, and two out-of-hours departments in Abingdon and Witney were approached (out-of-hours and practice demographic information, see Appendix 6.1). One extra practice from Oxford participated for the initial three weeks of the study.

6.3.2 Recruitment of parents and carers for the questionnaire

Participants were sampled from a single geographic setting (Oxfordshire) in order to maximise response rate. This could also help to obtain results that may be representative of an area with similar demographics to that of the UK. Parents and carers over 18 years of age caring for a child 5 years or under were included. Carers were defined for the purpose of this study as anyone over the age of 18 years of age (e.g. nanny, friend of the family) who provided support for the care of a child under 5 years of age. A minimal amount of 8 hours of care weekly every week was required to be eligible.

A convenience sample was obtained from those parents and carers that were registered in the practices and visited them, and for those who visited the out-of-hours services. Potential participants self-selected themselves, and were approached by the author when he visited the out-of-hours services and practices between August and November 2013. A poster was put up in the waiting rooms explaining the study, which advised parents and carers to ask the receptionist or the doctor for an information pack containing the study information. The information pack provided the PIS, an invitation letter and the questionnaire (see appendix

6.2 for PIS, invitation letter and copy of the questionnaire). Participants who received an information pack were then asked to read through the information provided, and if they were willing to take part in the study they could fill in the questionnaire attached to the form. Participants were advised to take as long as they required to fill in the questionnaire. One empty sealed box was left in the waiting room of the practices and the out-of-hours departments. The box had a mail slot where participants could introduce their questionnaire safely in their own time. Once participants had left the completed questionnaire inside the box it concluded their participation in the study.

6.3.3 Data analysis

6.3.3.1 Quality assessment of the data

The author extracted all the data from the questionnaires, and inputted each one of the questions from the questionnaire into an excel database. All extracted data was then checked by a second researcher (BF); where any discrepancies were raised these were resolved by consensus.

6.3.3.2 Statistical methods

Descriptive statistics were used to analyse all variables extracted from the data, mathematical summaries were used to describe the data. Categorical (nominal and ordinal) and numerical data (discrete) were used to describe variables,[37] and 95% confidence intervals (CI) were used where appropriate. Data extracted was divided in socio-demographic related data, data related to knowledge of fever and temperature taking forming the main body of the questionnaire (Questions 1 to 18).

Microsoft Excel 2010 was used to analyse all variables. IBM SPSS Statistics 19 was used to analyse the relationship between number of children cared for and knowledge about fever and its care.

For the analysis of the comments from the final data section no themes were anticipated. Data was identified, coded into themes and explored using the constant comparison method;[38] this was helpful in order to create different codes and redistribute the data into existing or new themes.

Section 1 – Analysis of socio-demographic data

Socio-demographic data was assembled in six different questions within the survey: Date of birth, gender, number of children cared for, age of children, marital status and work situation.

Date of birth was divided in 6 different categories to have a comprehensive adults age breakdown[39] from 18 to over 75 years of age, all data was summarised in percentages. These age group classifications were the same as the ones shown by the Family Resources Survey 2013/14 produced by the Office of National Statistics for the Department of Work and Pensions, with the inclusion of carers from 18 years of age and above as suggested by the Research Ethics committee.

Gender was classified in both genders (male and female). Number of children cared for was divided in three categories (one child, two children and three or more children) and data displayed using percentages.

After meeting two experts from the Centre of Evidence-Based Medicine at the University of Oxford (CH and MT), age of children cared for was divided in five different groups. Categories under 3 months and between 3 to 6 months were included as distinctive age thresholds to care as specified within the NICE guideline,[1] each one of these age categories were expressed in proportions. Questionnaire only included participants that cared for at least one child of 5 years of age or under.

Finally, marital status included 6 categories and work situation 7 categories and these categories were created during the process of developing the survey. Categories were summarised as proportions.

(See questionnaire in Appendix 6.2 for socio-demographic questions).

Section 2 – Analysis of fever knowledge and management data

A) Questions 1 to 11

The first question in the survey asked participants to provide in centigrade degrees (°C) the temperature they considered to be high. The second question explored carer understanding of how high a fever could become (°C) in a child if it was not treated with antipyretic medications (ibuprofen or paracetamol). Both questions were divided into seven groups including temperatures ranging from below 37 °C to above 41.5 °C, or whether participants did not know the answer. This division corresponded to temperature thresholds previously reported by parents,[12 14 15] proportions of each one of the subgroups were obtained.

Participant's opinion of the greatest harms which fever could cause in a child (Question 3) was sought. Participants suggested many different types of responses (76), an ongoing process tried to include responses into smaller subgroups. After several stages discussing all responses type with two experts from the Centre of Evidence-Based Medicine at the University of Oxford (CH and MT) results were classified in 23 subgroups. These questions were then coded into three main categories: extremely serious consequences, less serious consequences and other and unsure categories. Question 4 investigated participants' thoughts of how low a temperature could become to cause the harms to a child they described in Question 3. Responses were classified into eight different groups, these included groups already mentioned in questions 1 and 2 along with two added groups (don't know and other or unsure categories) and were expressed in proportions.

Participants' worries about the effects of fever on a child were investigated (Question 5). Answers were arranged into six groups, from not worried to very worried, not knowing or other or unsure categories, percentages from each one of the categories were obtained. Afterwards, how often (in minutes and hours) participants would continue taking temperature measurements if they thought a child had a fever (Question 6) was explored. This question was further classified in groups that included whether they did not use thermometer, other methods and other or unsure categories. Proportions of all groups were examined.

Temperature at which participants would administer antipyretic medication was sought (Question 7). Responses were divided in groups already mentioned in Question 4; percentages were obtained from each group. Furthermore, Question 8 aimed to understand how often participants would administer antipyretic medication. Seven major categories were formed and classified in 22 different subgroups. This information related to the frequency in which they administered the medication, or whether this timing was related to indications from the medication or prescribed to them by GPs. Caregivers expressed this information in broader terms (often, not often, always, never) or with the frequency they perceived as necessary for the child to get better. In addition, alternating medication (how many hours of separation participants gave one antipyretic medication from another type of antipyretic), and, other collated answers from participants that did not know and were not sure when to administer the medication, formed the last two categories. Percentages were obtained from each subgroup.

Participants were asked whether they would wake children during the night in the case of fever (Question 9). Answers were classified into six different groups consisting of whether they did wake or not children up. Other groups included waking the children up if they were worried, or if it was stated on the medicine, and also, whether they did not know or did not answer the question. Proportions were obtained from each group.

Question 10 examined participants' management of fever with other methods not previously mentioned. Answers were further classified into 11 categories which included binomial (yes and no) answers, not specified methods, rest, traditional methods, unsure methods and medication. Cooling strategies and drink were further classified in subgroups and percentages of all categories were analysed.

Participants' sources of information about fever management were explored in Question 11. The survey offered several options to respondents. These included family, GPs, other healthcare professionals, or other, participants who did not answer were also considered. Proportions were used to analyse all these options.

(See questionnaire in the Appendix 6.2 for fever knowledge and management questions).

B) Questions 12 to 18

Participants' use and knowledge of thermometers

Caregivers were enquired whether they had ever used a thermometer to take a child's temperature (Question 12). A dichotomised response (yes or no) was presented to participants. Moreover, what type of thermometer/s participants used was explored (Question 13), providing respondents 7 options to choose from. Options varied depending on which type of thermometer participants owned or whether they did not have one. Percentages were used to describe each group all responses. Sources from which participants acquired knowledge to read a thermometer were also investigated (Question 14), for this purpose they were presented with 7 different options. These sources related to thermometer instructions, health services staff advice, friends and family or other, all the groups were described as percentages.

Participants' care of fever in relation to the NICE guideline

The survey tried to understand temperature thresholds suggested by NICE guidelines and whether it prompted caregivers to take an infant younger than 3 months (Question 15), or from 3 to 6 months (Question 16) to a GP practice or an out-of-hours service. A scale of continuous temperature from 35 to over 39 °C was displayed for participants to choose a temperature/s at which they would decide to take the children they care for further into primary care. Responses were grouped as in Questions 4 and 7 and presented in proportions. Caregiver management of fever examined how participants took care last time the child they were caring for had a fever (Question 17). Six options were provided to them, these included: whether they gave paracetamol or ibuprofen alone, whether they provided these antipyretics alternatively or at the same time, whether they took no action or whether they used other types of management. Moreover, the number of participants who offered regular drinks to the children they cared for when they thought they had a fever (Question 18) was analysed. Three options (yes, no or I don't know) were display for them to choose from. All the groups were analysed in percentages.

(See questionnaire in the Appendix 6.2 for thermometer use and knowledge and care of fever).

6.3.3.3 Any other comments that participants would like to add that have not been covered in the questionnaire

Section 3

A blank section was added at the end of the questionnaire for participants who wished to include any other comments or information they felt were not covered. Comments obtained were classified in four different themes. The first theme was formed by participants' comments on fever knowledge; subdividing fever as a sign of illness or whether it was

dangerous or not. The second theme constructed was fever management, which was further classified in actual decisions and/or actions caregivers would use to manage a child's fever, or whether they received help or instruction to manage it from a relative. The third theme was participants' knowledge of temperature measurement. The final theme was constructed by caregivers' observations about the questionnaire itself. These were further divided into participants' enquiring about further information, their positive thoughts of the use of this questionnaire or their suggestions for a further survey.

(See questionnaire in Appendix 6.2 for any other comments).

Relationship between number of children and knowledge and care of fever

For this purpose the number of children classified as 1 (1), 2 (2) and 3 or more (3) was compared with seven of the survey questions.

Comparisons of number of children (categorical ordinal data) with what caregivers considered a high temperature (Question 1), how high could it go if it was not treated with antipyretics (Question 2) or above what temperature did they provide antipyretics (Question 7) were performed using the Mann-Withney U test. Furthermore, participants' understanding when to take a child under 3 months (Question 15), and from 3 to 6 months (Question 16) to a practice or an out-of-hours were analysed using the same method. Mann-Withney U test is a test used for non-parametric distributions to understand whether there are differences between two different groups. This analysis was carried out as these questions were composed of continuous data (numerical). After reviewing whether this data was normally distributed (using SPSS and a contingency table the author checked for normality of the data), means between number of children and each of these questions were analysed using a Mann-Withney U test.

Number of children (1, 2 and 3) were also compared with how worried participants were with the effects fever can have (Question 5), and how often participants continue to check their child's temperature (Question 6). After statistical advice (L-M Y) responses from question 5 and 6 were coded in order to help analysis (see coding for analysis Appendix 6.3). Chi Square and Fisher's exact test were used to investigate the association between having one or more children and Questions 5 and 6. Chi Square was used in order to understand if there was a significant effect of having one (1), two (2) or 3 or more children (3) and being more or less worried about fever (Question 5), as well as how often carers would measure temperature (Question 6). When the sample size was smaller Fisher's exact test was used to examine the significance of the association between having one (1), two (2) or 3 or more children (3) and being worried (Question 5) and the frequency in which carers measured temperature.

Ethical considerations

An ethical full REC committee from North Wales (Central & East) reviewed this study. Changes were required for the focus group interview (not for the questionnaire) in terms of not providing any information regarding the NICE guideline or mentioning of it, also the focus group would be formed only by parents and no carers. After a re-submission favourable opinion was granted for this study Rec. Ref. 13/WA/238 (see Appendix 4.1 for full protocol).

6.4 Results

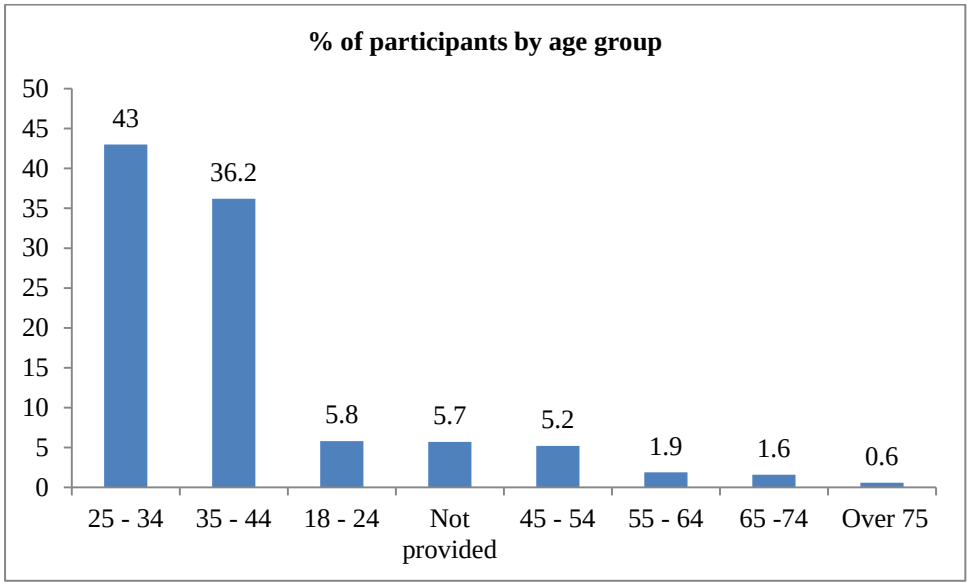
A total of 335 questionnaires were collected, from which 26 (7.8%, 95% CI, 4.9% to 10.7%) were not taken into account as they did not provide the child's age and/or were not entirely completed (i.e. only 5 questions completed). A total of 309 questionnaires were therefore included for this survey.

Most of the questionnaires were collected from two out-of-hours departments in Abingdon (175, 56%) and Witney (102, 33%) in Oxfordshire. Three participating practices in Oxford provided the rest of the questionnaires: 27 Beaumont Street Practice (22, 7%), The Manor Surgery (7, 2.3%) and 28 Beaumont Street Practice (5, 1.6%). After a period of three weeks one of the surgeries dropped out of the study; however, collected questionnaires were accounted for towards the final number of surveys collected (see Appendix 6.1 for socio-demographic data from participating trusts).

6.4.1 Section 1 – Socio-demographic data

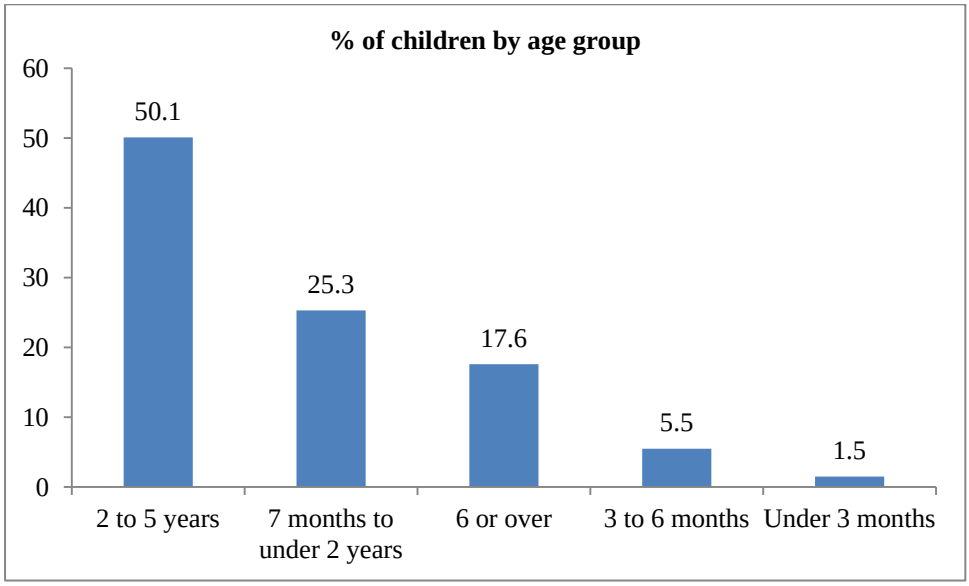
Figure 6.1 shows that the majority of participants were women (76%, 95% CI, 72% to 81%) and most were aged between 25 to 34 years (133, 43%) followed by those aged 35 to 44 years (112, 36%) (see Figure 6.1).

Figure 6.1 – Age of participants



Overall respondents reported to care for a total number of 529 children, with the majority corresponding to children aged from 2 to 5 years (265, 50%), and children 7 months to under 2 years of age (134, 25%) (see Figure 6.2).

Figure 6.2 – Children's age



Most participants described being married or living with a partner (263, 85%, 95% CI, 81% to 89%). Less than one in 10 reported being single (25, 8.1%), others reported being divorced or separated (11, 3.6%) or in a civil partnership (6, 1.9%). The greatest number stated being

in full-time employment (138, 44%, 95% CI, 39% to 50%), doing part-time work (90, 29%, 95% CI, 24% to 34%), whilst the third largest group was formed by respondents that were looking after the home/family (65, 21%, 95% CI, 16% to 25%) (see Table 6.1).

Table 6.1 – Marital and work status

Marital status	No.	%	Work status	No.	%
Married or living with a partner	263	85.1	Full-time paid work	138	44.7
Single (never married)	25	8.1	Part-time paid work	90	29.1
Divorced or separated	11	3.6	Looking after home/family	65	21.0
Civil partnership	6	1.9	Student	7	2.3
Widowed	2	0.6	Retired	6	1.9
Other	2	0.6	Unemployed	3	1.0

6.4.2 Section 2 – Fever knowledge and management

A) Questions 1 to 11

Question 1 enquired participants' knowledge of what a high temperature was for them in °C. Almost half of the responses considered a high temperature to ranges from 38 to 38.9 °C (44%, 95% CI, 39% to 49%). This was followed by temperatures between 37 to 37.9 °C (25%, 95% CI, 20% to 30%) and 39 to 39.9 °C (21%, 95% CI, 17% to 25%). When respondents were asked how high a fever could get in children treated without antipyretic management (Question 2), almost half of the responses mentioned temperatures between 40 to 41.5 °C (49%, 95% CI, 44% to 54%), followed by temperatures above 41.5 °C (21%, 95% CI, 17% to 25%) (see Figure 6.3 for Questions 1 and 2).

Figure 6.3 – What is a high temperature (Question 1) and how high it can get if not treated with antipyretics (Question 2)

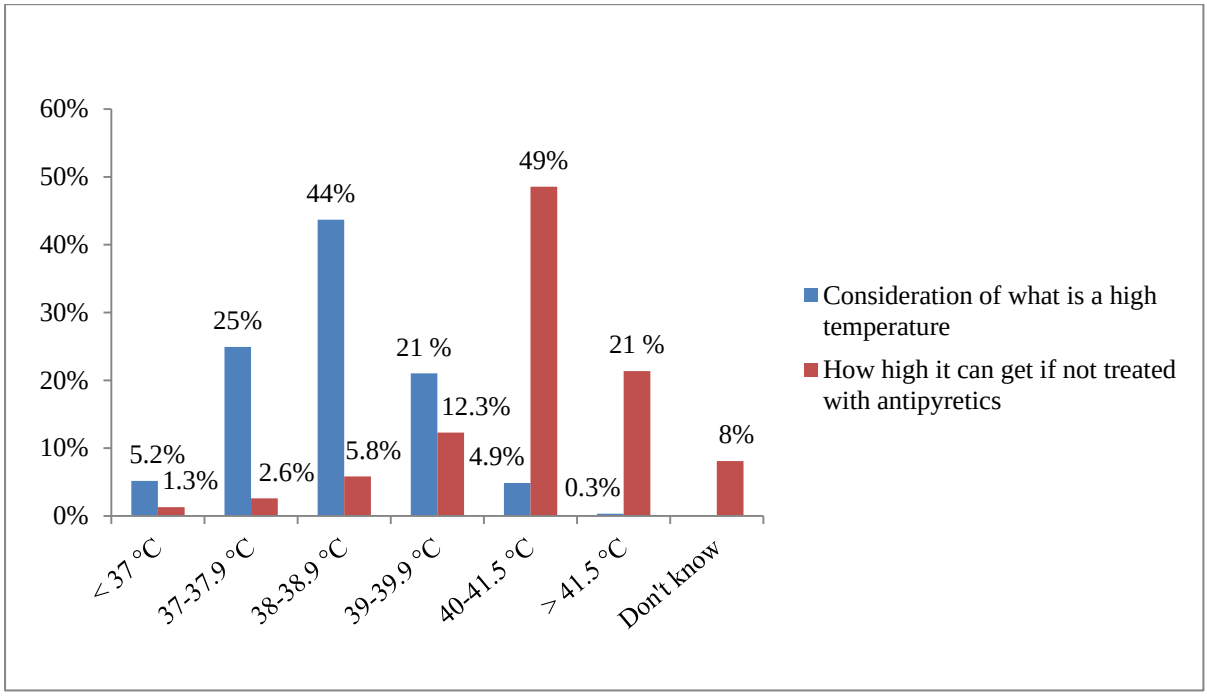


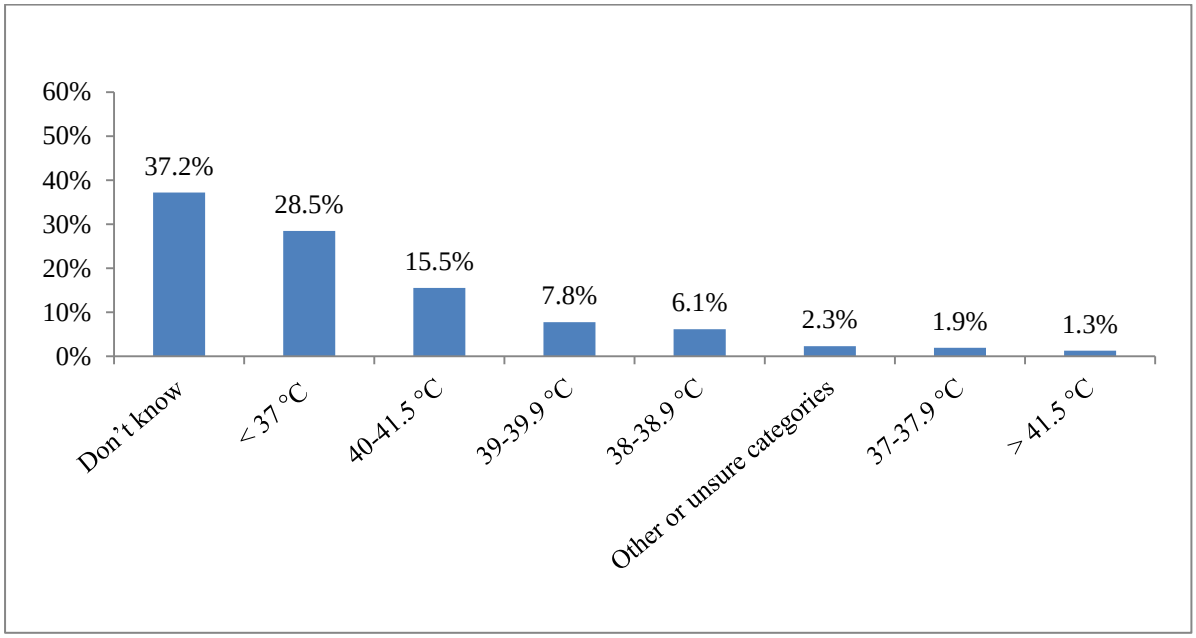
Table 6.2 shows that extremely serious consequences were often described by participants, with fits mentioned the most, followed by death and brain damage. Less serious consequences were also described by respondents, the most widely mentioned included dehydration, vomiting and hallucination.

Table 6.2 – What is the greatest harm that high fever can cause to a child

A) Extremely serious consequences	No.	%
1 - Fits	138	30.5
2 - Death	83	18.4
3 - Brain damage	57	12.6
4 - Loss of conscious	23	5.1
5 - Organ damage	19	4.2
6 - Other serious illness/complications	15	3.3
7 - Serious consequences (leading to other illnesses)	11	2.4
8 - Breathing	6	1.3
B) Less serious consequences		
9 - Dehydration	29	6.4
10 - Vomiting	13	2.9
11 – Hallucination/disorientation	8	1.8
12 - Tiredness	6	1.3
13 - Pain	5	1.1
14 - Stress on the body	4	0.9
15 - Shivering	3	0.7
16 - Prolonged illness	2	0.4
17 - Headache	2	0.4
18 - Poor feeding	2	0.4
19 - Infection	2	0.4
20 - Feeling generally ill	1	0.2
C) Other and unsure categories		
21 - Don't know	15	3.3
22 - Other	7	1.5
23 - Other minor consequences	1	0.2

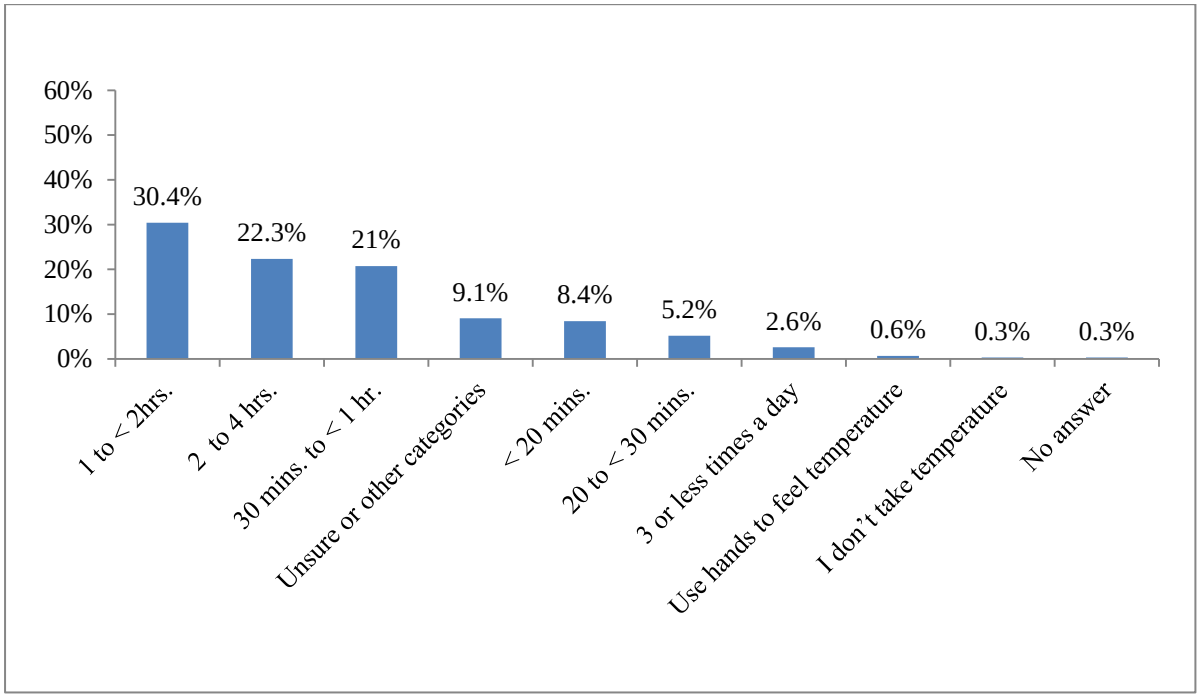
Question 4 explored examined participants' thoughts of what is the lowest temperature that can cause the type of harms mentioned (Question 3). Figure 6.4 shows that over a third of respondents did not know the answer and more than a fourth of responses related to temperatures below 37 °C.

Figure 6.4 – How low a temperature can cause the harms mentioned in Question 3



Almost half of the respondents were very worried about the effects of fever (43%, 95% CI, 38% to 48%). Figure 6.5 shows about a third of respondents would measure temperature between one to two hours and about the same between two to four hours or 30 minutes to an hour. However, some participants did not answer or said they did not take temperature measurements (0.3%, 95%, 0.001% to 2.11%) and two respondents used their hands to measure temperature (see Figure 6.5).

Figure 6.5 – How often they will continue measuring temperature in the presence of fever



When participants were asked at which temperature they would administer antipyretic medication (Question 7), over half suggested temperatures between 38 to 38.9 °C (53%, 95% CI, 48% to 58%). However, almost a third cited temperatures between 37 to 37.9 °C (29%, 95% CI, 24% to 34%) and some parents responded below 37 °C (7.8%, 95% CI, 4.9% to 10.7%). In terms of how often antipyretic management was administered to feverish children (Question 8), seven major categories were considered. Table 6.3 displays different approaches in which caregivers would administer paracetamol or ibuprofen. Most respondents suggested providing antipyretics at specific times, in which providing them every four hours was the most common answer; however, antipyretics were also administered by a small amount of participants under two hours, and one in 10 participants would administer them every 6 or more hours.

Table 6.3 – How often do you give paracetamol or ibuprofen

According to package or bottle instructions or as directed	No.	%
Package or bottle instructions	40	11.4
As directed	7	2.0
Total	47	13.4
At specific times		
Every 4 hours	115	32.9
Every 4 to 6 hours	28	8.0
Every 6 hour	20	5.7
Every 2 hours or less	15	4.3
Imprecise	15	4.3
Every 2 to 4 hours	11	3.1
Every 6 to 8 hours	4	1.1
Every 8 hours	3	0.9
Once a day	2	0.6
Total	213	60.9
Alternating medicine		
Alternating ibuprofen every 6 hours and paracetamol every 4 hours	13	3.7
Alternating ibuprofen and paracetamol every 2 hours (every two hours paracetamol, every 2 hours ibuprofen)	10	2.9
Alternate antipyretics not specified or other	7	2.0
Every 8 hours ibuprofen, 4 to 6 hours paracetamol	4	1.1
Total	34	9.7
Not often or never		
Not often	10	2.9
Never	4	1.1
Total	14	4.0
Often		
Often (including as often as allowed)	9	2.6
Total	9	2.6
As required for condition to improve		
If temperature over certain threshold, suspected fever or condition	14	4.0
When considered necessary	7	2.0
As far as condition does not improve	3	0.9
When other method does not work	3	0.9
Total	27	7.8
Other or unsure categories		
No answer	4	1.1
Not sure	2	0.6
Total	6	1.7

Participants were asked whether they would wake the child they are caring for up at night in the case of fever (Question 9), to which over half of the carers responded no (58%, 95% CI, 52% to 63%), about a quarter responded affirmatively (25.6%, 95% CI, 21% to 30%) or that they will wake the child up only if they were worried (15.2%, 95% CI, 11.2% to 19.2%).

The survey tried to examine whether respondents used other methods not mentioned previously. For this purpose, Question 10 enquired whether respondents would use any other methods to treat a child's fever. Over a third of the participants suggested using cooling

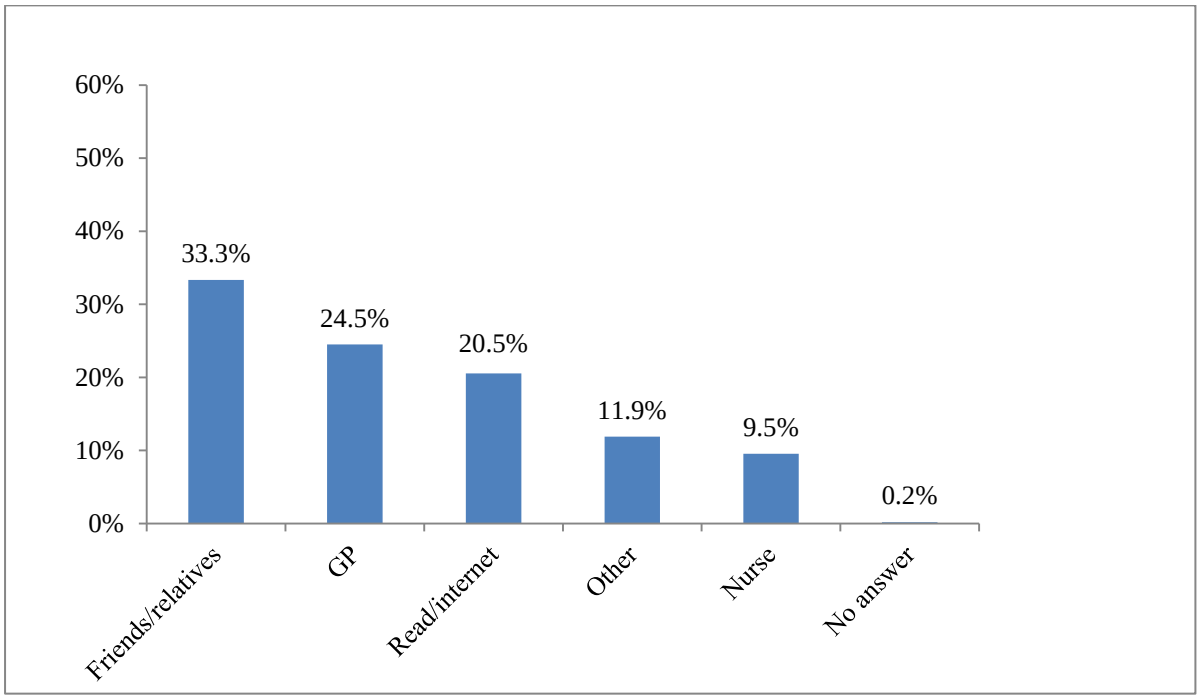
strategies such as strip children's clothing and bedding or opening windows. This was followed by a quarter reporting the use of sponging and wet clothing to reduce temperature, and about one in 10 reported not to use any methods. One in 10 participants gave drinks to the child such as cool drinks or in the form of popsicles (see Table 6.4).

Table 6.4 – Will you use other methods to treat the fever

Other methods to treat fever	No.	%
Sponging/ wet clothing	113	25.7
No	57	13
Bath	17	3.9
Yes unspecified	9	2
If prescribed	3	0.7
Drink		
Water/cool drink	45	10.2
Rest	4	0.9
Very cold water/Ice/Popsicles	3	0.7
Cooling strategies		
Strip clothing/bedding/light clothing	113	25.7
Open window/reduce or adjust room temperature	25	5.7
Other or unsure methods	19	4.3
Keep cool unspecified	16	3.6
Medication	8	1.8
Fan	5	1.1
Traditional methods	3	0.7

The survey enquired about participants' sources of knowledge about care of fever, (Question 11). Figure 6.6 shows that a third of participants mentioned friends and relatives were their main source of information, followed by one in four respondents mentioning GPs and about one in five reporting reading or searching the internet. Other sources of information mentioned were heterogeneous, including training and education, learning for themselves or NHS trusts such as hospitals, A&E and ambulances.

Figure 6.6 – Where did you learn your ideas about fever management



B) Questions 12 to 18

Participants' use and knowledge of thermometers

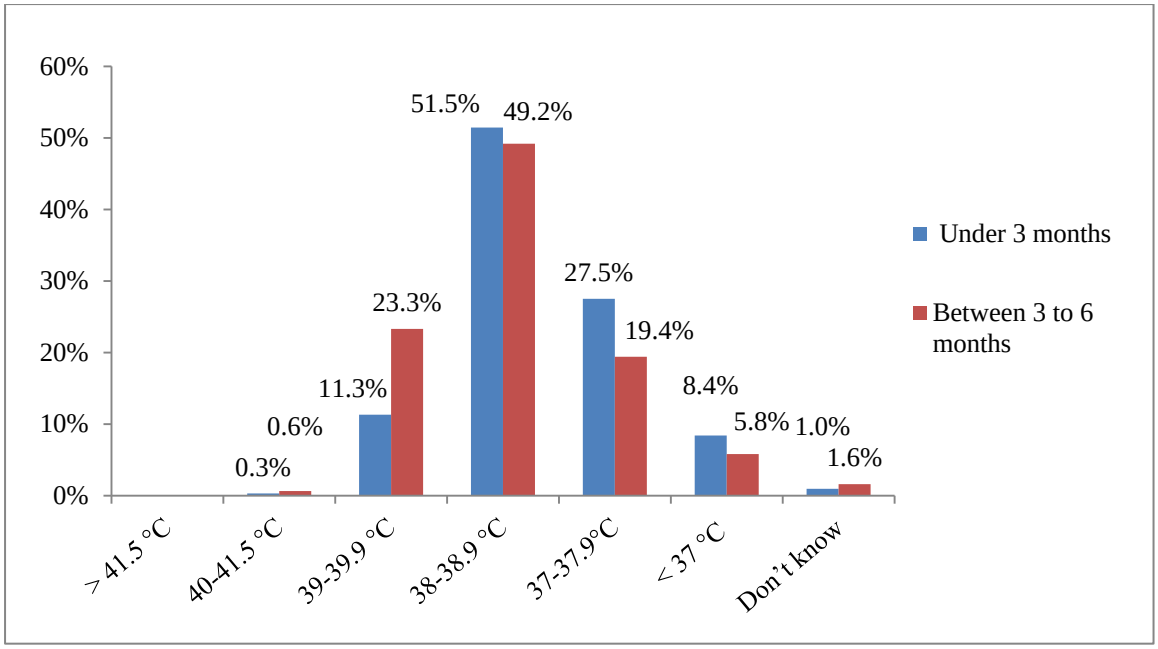
Most participants reported to have a thermometer at home (97%, 95% CI, 95% to 99%) (Question 12). The most common thermometers owned were electronic, followed by infrared (ear), forehead chemical thermometers and forehead thermometers. However, other methods such as mercury in glass thermometers (4.2%, 95% CI, 2.1% to 6.4%) were still being used.

Over half of the participants' answers reported thermometer instructions (57%, 95% CI, 52% to 62%) as the most usual way for them to learn to use a thermometer (Question 14). This was followed by mentioning they learned from friends and family advice (20%, 95% CI, 16% to 24%), guidance from healthcare staff (7.7%, 95% CI, 4.9% to 10.6%), or other sources (11%, 95% CI, 7.5% to 14%).

Participants' care of fever in relation to the NICE guideline

Caregivers were asked at what temperature they will take an infant, younger than 3 months (Question 15) or between 3 to 6 months (Question 16), to a GP practice or an out-of-hours service. Temperature thresholds were further classified in 6 groups in both infants, under 3 months or between 3 to 6 months. Figure 6.7 shows the most common temperature threshold mentioned was between 38 to 38.9 °C, followed by temperatures between 37 to 37.9 °C and 39 to 39.9 °C.

Figure 6.7 – At what temperature would you take an infant to a GP or an out-of-hours service



In order to understand management of fever, participants were asked how they cared for fever last time the child they were caring for had a fever (Question 17). Providing paracetamol alone and paracetamol and ibuprofen alternatively were the most frequent options with the same number of respondents (34%, 95% CI, 29% to 39%). Respondents also mentioned they administered paracetamol and ibuprofen at the same time (10%, 95% CI, 6% to 13%), however, some respondents stated they did nothing and one did not answer.

When caregivers were asked whether they provided water regularly to children when they had a fever (Question 18) almost all said they did (299, 97%, 95% CI, 95% to 98%).

6.4.3 Section 3

Any other comments that participants would like to add that have not been covered in the questionnaire

About one in 10 participants added a comment at the end of the questionnaire. Additional information was further classified in four themes after coding (see Appendix 6.4).

The first theme, regarding fever knowledge, was further divided as a sign of illness or as not being dangerous. As a sign of illness participants thought that fever was an indication of infection and accompanies childhood illnesses. Three respondents answered that fever was not dangerous, acknowledging fever as a defence mechanism that the body uses when infection appears: "*I believe that fever is only a defence mechanism of the body*". Another respondent suggested that some fevers can be treated at home: "*From my experience temperature alone is not a reason to take a kid to seek medical care*". One respondent mentioned that having an older child would give her a better sense of when a child is really sick.

The second theme related to the management of fever with antipyretics, such as paracetamol and ibuprofen being the most usual description. Contacting an out-of-hours GP, or calling the NHS line (NHS direct) was also mentioned: "*If child is over 39 °C will be calling the NHS line*". Some participants also mentioned receiving instructions from family members.

The third theme related to participants' knowledge of temperature measurement. One participant relied exclusively on thermometer readings and accompanying thermometer information, while another one based temperature judgements on touch: "*I can feel if my*

grandchildren have temperature just by feeling their body". A third participant acknowledged not to understand the differences on the temperature display showed by infrared thermometry when measuring different ears, "*I am not clear about the discrepancy between the temperatures of each ear when taking my child temp. I use an infrared thermometer and the temperature usually varies by half a degree when taking the temp. I go by the highest reading to be on the safe side. This is not including times when a difference would be expected, such as when they have been sleeping on one ear which will naturally have warmed up*".

The fourth theme, regarded comments about the questionnaire, it was further divided into three groups. In the first group participants noted they wanted extra information about fever care, one participant enquired: "*How long do you leave it (calpol) until you seek further medical attention*", and another, wanted to know about the accuracy of different thermometers: "*Limitations of different types of thermometers in terms of accuracy*". The second group related to participants suggesting extra content within the questionnaire, such as: "*Volume of medicine has not been asked*", and, "*Questions need to be age specific*". The final group were positive comments about the questionnaire such as: "*Good way of testing people's knowledge*", or "*Extremely interesting has revealed how little I actually know*".

Relationship between number of children and knowledge and care of fever

One-way analysis of variance was performed comparing participants caring for one (1), two (2) or three or more (3) children (see Appendix 6.3, coding for analysis) with what respondents considered a high temperature was (Question 1, $p = 0.134$), how high the fever can go if not treated with antipyretics (Question 2, $p = 0.879$) or above which temperature they will administer antipyretic medication (Question 7, $p = 0.520$). Furthermore, this analysis was also performed to responses mentioning at which temperatures caregivers will take infants under 3 months (Question 15, $p = 0.226$) and between 3 to 6 months (Question

16, p = 0.336) to a GP or an out-of-hours service. No significant relationship was found between the number of children and any of the questions.

Table 6.5 shows the mean temperature which carers of one, two or three or more children considered as a high temperature (Question 1), how high this temperature can become if the fever is untreated (Question 2) and above which temperature carers will decide to administer medication. This table also shows at what temperature carers will decide to take a child under 3 months or between 3 to 6 months for further care. There was little evidence of significant differences with wide overlapping confidence intervals, low fever thresholds were defined as a high temperature (≥ 37.8 °C) and untreated temperatures were thought to rise up to 42 °C.

Table 6.5 – Temperature considered high and that prompt carer action

Questions	**1 child Mean temperature (95% CI)**	**2 children Mean temperature (95% CI)**	**3 or more children Mean temperature (95% CI)**
High Temperature (°C) Question 1	38.0 °C (31.1 to 44.9 °C)	38.1 °C (37.95 to 38.25 °C)	38.0°C (37.8 to 38.2 °C)
How high can it go if untreated (°C) Question 2	41.1 °C (34.22 to 47.98 °C)	40.8 °C (40.25 to 41.35 °C)	41.1 °C (40.74 to 41.46 °C)
Above what temperature will you give medicine (°C) Question 7	37.4 °C (30.56 to 44.32 °C)	37.7 °C (37.55 to 37.85 °C)	37.4 °C (37.21 to 37.59 °C)
Above what temperature would you take a baby younger than 3 months to a GP practice or an out-of-hours (°C) Question 15	37.7 °C (30.82 to 44.58 °C)	38.0 °C (37.9 to 38.1 °C)	37.7 °C (37.61 to 37.79 °C)
Above what temperature would you take a baby 3 to 6 months to a GP practice or an out-of-hours (°C) Question 16	38.0 °C (31.12 to 44.88 °C)	38.2 °C (38.1 to 38.3 °C)	38.0 °C (37.91 to 38.09 °C)

Mann-Withney U tests were used to understand whether there was a difference between the number of children cared for by respondents (1, 2 or 3) and what they considered a high temperature (Question 1, p = 0.066), how high a temperature they thought could go if not

treated (Question 2, p = 0.972) or above what temperature they would provide medicine (Question 7, p = 0.179). Furthermore, this test was also used to understand whether there were differences between the number of children cared by respondents and the temperature above at which they would take a baby younger than 3 months (Question 15, p = 0.193) or between 3 to 6 months (Question 16, p = 0.170) to a GP practice or an out-of-hours. No significant differences were found between the number of children and any of the questions.

Chi Square and Fisher's exact test were used to investigate the association of number of children cared for by respondents (1, 2 or 3) and how worried they were about the effects of fever (Question 5, p = 0.242), or how often they will continue to measure temperature (Question 6, p = 0.468). No significant relationship was found between the number of children and any of the questions.

However, a lower percentage of caregivers that cared for three or more children seemed to be very worried (33.3% vs. 45.7% and 48.9%) when compared with those who cared only for one or two children (see Table 6.6). Nonetheless, no significant differences were observed when looking at the confidence interval. This could be due to an insufficient sample size to detect differences between the different groups.

Table 6.6 – Percentage of caregivers with different number of children reporting to be worried or very worried

	Count and percentage	No worried	Not too worried	Worried	Very worried	Total
1	Count	4	35	29	65	133
	% within Number of children	3.0%	26.3%	21.8%	48.9%	100.0%
	% of Total	1.4%	11.9%	9.9%	22.1%	45.2%
2	Count	10	30	23	53	116
	% within Number of children	8.6%	25.9%	19.8%	45.7%	100.0%
	% of Total	3.4%	10.2%	7.8%	18.0%	39.5%
3 or more	Count	3	18	9	15	45
	% within Number of children	6.7%	40.0%	20.0%	33.3%	100.0%
	% of Total	1.0%	6.1%	3.1%	5.1%	15.3%

Further aggregating data from the worried and very worried groups (see Table 6.7) shows that differences between those participants that worry the most and the least was even greater. Less caregivers that cared for three or more children seemed to be very worried when compared with those who cared only for one or two children (53.3% vs. 65.5% and 70.7%).

Table 6.7 – Percentage of caregivers that worry more versus those who worry less

	Count and percentage	No worried	Not too worried	Worried and very worried	Total
1	Count	4	35	94	133
	% within Number of children	3.0%	26.3%	70.7%	100.0%
	% of Total	1.4%	11.9%	32.0%	45.2%
2	Count	10	30	76	116
	% within Number of children	8.6%	25.9%	65.5%	100.0%
	% of Total	3.4%	10.2%	25.9%	39.5%
3 or more	Count	3	18	24	45
	% within Number of children	6.7%	40.0%	53.3%	100.0%
	% of Total	1.0%	6.1%	8.2%	15.3%

In order to understand whether there may be a difference between the age of the respondents and feelings of worry, the age of the respondent and their feelings were compared using a

contingency table. No statistical significant difference was found between any of the groups (p = 0.255); however, a greater number of 18 to 24 years seemed to be very worried (65%, CI, 59.7% to 70.3%) when compared with the rest of the groups. This was followed by age groups 55 to 64 years (60%, CI, 54.5% to 65.5%), and 65 to 74 years (60%, CI, 54.5% to 65.5%) (see Table 6.8).

Table 6.8 – Relationship between respondent date of birth and feelings of worry

Age	Count and percentage	Not worried	Not too worried	Worried	Very worried	Total
18 -24	Count	0	3	3	11	17
	% within DOB*	0%	17.6%	17.6%	64.7%	100%
	% of Total	0%	1.1%	1.1%	4%	6.1%
25 - 34	Count	5	41	22	56	124
	% within DOB	4%	33.1%	17.7%	45.2%	100%
	% of Total	1.8%	14.7%	7.9%	20.1%	44.6%
35 - 44	Count	9	32	25	44	110
	% within DOB	8.2%	29.1%	22.7%	40%	100%
	% of Total	3.2%	11.5%	9%	15.8%	39.6%
45 - 54	Count	0	3	5	7	15
	% within DOB	0%	20%	33.3%	46.7%	100%
	% of Total	0%	1.1%	1.8%	2.5%	5.4%
55 - 64	Count	1	0	1	3	5
	% within DOB	20%	0%	20%	60%	100%
	% of Total	0.4%	0.0%	0.4%	1.1%	1.8%
65 - 74	Count	0	1	1	3	5
	% within DOB	0%	20%	20%	60%	100%
	% of Total	0%	0.4%	0.4%	1.1%	1.8%
75+	Count	0	0	2	0	2
	% within DOB	0%	0%	100%	0%	100%
	% of Total	0%	0%	0.7%	0%	0.7%

*DOB (date of birth) relates to the specific age group

Carer definition of a high temperature and their intention to take the children they care for to a GP or an out-of-hours were compared using a contingency table. No statistical difference was found between definitions of high temperature and taking a child under 3 months or between 3 to 6 months to a GP or an out-of-hours service (p = 0.199). However, a greater number of parents took their children to a GP practice or an out-of-hours at temperatures between 37.5 (23, 9.3%)°C to 39 °C (50, 20.2%) both in the groups of those who cared for children under 3 months and between 3 to 6 months (see example in Appendix 6.5).

6.5 Discussion

Caregivers are not always informed about what a high temperature is, and most thought a fever could have harmful consequences. Most participants were worried or very worried about fever, would measure temperature often and would not always use adequate methods to care for a feverish illness. The main findings from this survey can be summarised as:

1) Caregivers' knowledge of fever was not always correct;

2) Caregivers' management of fever was not always adequate;

3) Caregivers' were often worried about fever;

4) Caregivers' understanding and use of temperature measurements was not always appropriate.

6.5.1 How it fits in the existing literature

Caregivers' knowledge of fever was not always correct

About one fourth of participants considered a temperature threshold of 37 to 37.9 °C a high temperature, this finding seems in line with the findings of Chapter 3 of this thesis which found a third of respondents thought this temperature to be a fever. These thresholds did not follow NICE guideline. Moreover, in this survey more than one in five participants thought that if a fever was not treated temperatures would rise above 41.5 °C.

Fits were cited as serious consequences by over a third of participants at similar to[14 30 36 40] or at higher levels than previously recorded in the literature.[24 35 41] Furthermore, in the survey one in five participants cited death, which seemed higher when compared with previous recent research.[14 28]

The main source of knowledge were family and friends, which influenced caregivers' knowledge and treatment of fever. However, most previous literature mentions GPs as caregivers' main source of information,[14 17 23] reported in Chapter 4.

Caregivers' management of fever was not always adequate

Over half of the participants would administer antipyretics, and almost a third at low temperature. A small number of participants administrated antipyretics under two hours, and more than one in 10 would administer antipyretic therapy every 6 or more hours. This means about one in four of caregivers may administer medication either too frequently or too unfrequently, may be under or overdosing children with their care.[20 42] Administering antipyretics between 4 to 6 hours in recommended doses per body weight have been generally regarded as safe and effective.[43] The NICE guideline suggested the use of antipyretics in case the child was stressed and not purely to reduce fever, it also suggested the change of antipyretic medication where stress was not solved.[29]

In terms of other therapies used, almost a third of participants suggested the use of non-recommended methods such as sponging or bathing. The literature highlights that these methods are often used. [9 17 18 26 44] One quarter suggested they would wake their children up at night in the case of fever, practices consistent with the literature.[32 45] However, even though these practices are not recommended by NICE, nearly all participants did keep children hydrated with water, a practice that is supported by the guidance.[29]

NICE guidance recognises children younger than 3 months with a temperature of 38 °C or over to be at a high risk of having a serious illness.[29] In this survey only about half of participants would take a child with these temperatures to a GP or an out-of-hours. Furthermore, the guideline also recognises children between 3 to 6 months, with temperatures of 39 °C or over, to be at least at intermediate risk of having a serious illness.[29] In this survey

less than a quarter of participants would take a child with these temperatures to a GP or an out-of-hours.

Caregivers were worried about fever

Most caregivers were worried or very worried about fever. These findings were still seen in those participants with 2 or 3 or more children, and of all age groups; however, a greater number of caregivers between the ages of 18 to 24 reported to be very worried. Participants' feelings of anxiety and worry or fever phobia (as described by Schmitt in 1980), has been described previously.[17 18 23 44] However, a lower percentage of caregivers that cared for 3 or more children seemed to be worried or very worried when compared with those who cared only for one or two children.

Caregivers' understanding and use of temperature measurements was not always appropriate

The majority of caregivers said they used thermometers to take a child's temperature; however, more than one in 10 of those thermometers mentioned were forehead chemical, which is not recommended. [1 29] Furthermore, a small number of participants reported still using mercury in glass thermometers, which are no longer recommended.

Over half of the caregivers measured temperature in less than two hours periods, which may show that participants are anxious to know about their children's temperature. Another interesting finding showed that over half of caregivers understood how to use thermometers from their information. Chapter 5 suggested the potential educational importance of thermometer inserts, and as shown in this chapter, for many it is a source of information on fever measurement and management.

6.5.2 The survey and its comparison with research with similar structure

Over three decades ago parental misconceptions about fever were first described by Schmitt.[23] This study observed caregiver's definition of fever with attention to their level of concern from it, their understanding of fever in children and their fever management and temperature monitoring aptitudes. More recent survey studies have been performed looking at similar aspects of fever knowledge, its care and management. Surveys from North America,[14] Japan,[17] Italy[28] or this survey from the UK have used adapted question from Schmitt's study, different trends can be identified from these studies.

Almost half of caregivers in this study (44%) thought that temperatures which constituted a fever ranged between 37.9 to 38.9 °C, which seems in accordance with previous studies (39%, 38% and 46% respectively).[14 17 23] A lower number of participants in this study (26%) suggested temperatures between 39 to 40 °C compared with previous North American studies (39% and 46% respectively);[14 23] however, a greater number of participants thought temperatures equal or lower than 37.8 °C were fever when compared with earlier studies[14 23] (see Table 6.9), which shows a heterogeneous understanding of fever from caregivers.[12 14]

Table 6.9 – Caregivers' understanding of fever and its harmful effects

	Schmitt, 1980 (USA)	Crocetti et al., 2001 (USA)	Sakai et al., 2011 (Japan)	Chiapini et al., 2012 (Italy)	Present study, 2013 (UK)
Caregiver's definition of fever					
≤ 37.8 °C	12%	5%	62%	–*6	30%
37.9 – 38.9 °C	46%	39%	38%	–	44%
39 – 40 °C	32%	45%	1%	–	26%
≥ 40 °C*	10%	10%	0%	–	1%
Level of concern*2					
Very worried	63%	56%	47%	–	43%
Somewhat worried	36%	34%	53%	–	27%
Not at all worried	1%	10%	0%	–	6%
How high can a fever go if left untreated*3					
≤ 40.6 °C	52%	71%	67%	44%	61%
40.7 – 43.2 °C	41%	21%	33%	53%	24%
≥ 43.3 °C	7%	7%	0%	3%	7%
Harmful effects of fever					
Seizure	15%	32%	28%	82%	31%
Brain damage	46%	21%	20%	8%	13%
Death	8%	14%	0%	4%	18%
Dehydration	4%	4%	4%	45%	6%
Really sick*4	12%	2%	0%	5%	2%
Coma	4%	2%	0%	3%	0%
Delirium	1%	1%	0%	22%	2%
Blindness	3%	1%	0%	1%	0%
Other	1%	14%	10%	5%	3%
Do not know	–	–	37%	–	3%
No response	6%	9%	2%	–	0%
Lowest temperature required to cause the type of harm listed above*5					
≤ 40 °C	52%	76%	91%	–	57%
≤ 37.8 °C	4%	35	4%	–	30%

Whole numbers only have been used in this table as some of these studies only used this nomenclature

* 0.6% over 40 °C in present study

*2 Worried 20%, other or unsure categories 2%, don't know 2% in present study

*3 Don't know 8% in present study

*4 Serious consequences from present study

*5 Don't know 37% and other or unsure categories 1.6% from the present study

*6 "–" Means the study does not mention it, as it was not asked

Participant concern was high with close to half of participants suggesting to be very worried about a child's fever; however, this number seemed lower than Schmitt's[23] results and lower than other more recent research.[14 17] Moreover, a lower number of responses suggested caregivers are somewhat worried about fever (27%) when compared with previous research (34%, 53% and 36% respectively).[14 17 23] A variety of factors may have influenced a lower number of caregivers being somehow worried, which may have been due to a higher level

education in the sample. The fact that most participants were recruited from out-of-hours clinic settings may also have had an impact i.e. becoming more afraid of a condition and, therefore, thinking of a greater damage from it.

Almost a third of responses in this survey suggested seizure to be the most common harmful effect from fever (31%), similar values were presented in recent studies (32% and 28% respectively)[14 17] with the exception of a recent Italian study (82%);[220] however, Schmitt in 1980, described about half that number (15%) of participants reporting seizure. Caregivers in this survey reported death as a result of fever in greater number (18%) than any of the previously compared studies (14%, 0%, 4% and 8% respectively).[14 17 23 28] Brain damage was the third biggest harm from fever in children mentioned in this study (13%), with the exception of a recent Italian study (8%),[28] this study seemed to report lower number of responses of brain damage to be the greatest concern. Furthermore, over half of the respondents (57%) suggested temperatures equal or below 40 °C were considered enough to cause the greatest harms similarly to previous studies.[14 17 23]

Most caregivers (61%) in this survey thought that if untreated fever will rise to 40.6 °C, which was similar to previous research (67 and 52% respectively).[17 23] Moreover, these survey results suggested the exact proportion of participants (7%) thought that untreated fever can rise to temperatures equal or above to 43.3 °C, which has been mentioned in two earlier studies.[14 23] This finding may imply that respondents may not understand the underpinning mechanisms of body temperature, not allowing body temperature to go either above or below a certain threshold or regulating it when necessary.[46]

Digital thermometers were the main type of devices used by participants in this survey, as suggested by other recent research.[12 28] This study highlights that mercury-in-glass thermometers (4.1%), or low accuracy devices such as forehead chemical strips are still being

used, as shown across the literature.[18 47 48] According to this survey, temperature was measured most often between one to two hours (30.4%), findings that seems in line with results from a recent Italian study (33.5%), showing respondents checked temperature with this frequency.[28]

This current survey showed a greater use of antipyretic medication at temperatures equal to or under 37.8 °C (36.2%), compared with previous studies,[14 17 23] and, very similar to previous North American studies[14 23] at temperatures of 38.8 °C (89%). Over a third of caregivers in this survey responded to administer antipyretic medication alternatively, which seems lower to previously reported research (67%).[49] Alternating different antipyretic medication is a medical practice that has been long recommended to health care providers for the treatment of feverish illness.[23 50] Moreover, caregivers knowledge of alternating antipyretics may be conveyed to them from sources such as health care providers.[49]

Cooling strategies involving sponging and bathing were described as normal practices by caregivers. These methods to reduce fever have been suggested in previous studies;[10 18 27 30 33] however, these practices have not been recommended by the NICE guideline.[1 29]

6.5.3 Implications for practice

This survey has shown the importance of parents owning a thermometer, as most of them learn to use them from the thermometer information. The findings complement results from Chapter 4, where parents who owned a thermometer seemed to be more comfortable measuring a temperature, as well as Chapter 5, where some devices included information about fever care. Using a reliable thermometer may be useful for caregivers to further understand and make reliable judgments when measuring temperature. However, findings from Chapter 5 showed that thermometer information may prompt users to see a practitioner; this could create unnecessary referrals, and should be taken into account.

It is important that caregivers are skilled in temperature measurement, are able to identify signs where medical attention is required and can care for fever according to established guidance. This may increase the appropriateness of cases that present to Primary Care daily. Direct GP's advice, posters and leaflets with indications what signs to look for during most common serious diseases and clear guidance for care and referral may also prevent unnecessary referrals.

6.5.4 Implications for further research

Temperature measurement together with the recognition of vital signs are a synergistic approach to identify disease when fever is present. Further studies, specifically looking at populations both in clinical and non-clinical settings, could help identify caregiver's knowledge and management of feverish illness. This research may be able to generalise findings to wider population settings, including ethnic minorities, as well as to confirm or not findings from this study.

Alternating antipyretic medication by caregivers has been reported in this study and recent research.[14 49] However, NICE guidance does not specify whether this is an adequate approach following high fevers.[1 29] Specific research looking at the extent of these practices by caregivers in the UK should be performed. Results from this survey showed that alternating antipyretic medication may be one of the most frequent methods used. This survey also suggested that participants may be under or overdosing children.

GPs and healthcare staff seem to be an important source for caregiver's interpretation of feverish illness and subsequent management of fever, as shown in this survey. However, understanding their current knowledge and aptitude in fever care for children appears to be scarce.[51-53] Furthermore, some parents, as suggested in Chapter 4, receive contradictory advice from GPs. Further research on health professionals' understanding of feverish illness

identification and care according to the latest guidance in the UK could be useful. Developing a common set of guidance information for parents would seem a sensible, pragmatic intervention worth developing.

6.5.5 Limitations

This survey aimed to recruit over 300 caregivers at Primary Care settings in order to be able to generalise the findings from this study to populations with similar characteristics, and achieved within this survey. A larger sample may increase further understanding of participants' responses; however, the survey succeeded in sampling a range of caregiver responses.

From 16 NHS health care trusts that the author approached in Oxfordshire, only three GP practices (from which one dropped out early in the study), and two out-of-hours services participated. A greater number of NHS health trusts could have increased the generalisation of the survey findings.

There was a lack of participation from daytime GP surgeries in this survey, this meant that most caregivers in this survey participated in out-of-hours services. From the author's experience, out-of-hours services were mainly used by parents or carers which found these services more convenient in terms of time (being able to use the service outside of working hours) or location (proximity to their homes). Other variables that may have occurred can be that caregivers were directed from GP practices to out-of-hours services, or participants thought their children's condition may be better cared for in these services. This may have shaped caregivers' responses in this study.

Carer dates of birth were divided in 6 different age categories, from a methodological point of view this could be a drawback and may have led to a possible loss of information. For this reason many cut points were used in order to create a smooth transition of values, this

classification was also used in a previous UK national survey. This data was thought not to be linear, as different age groups could be caring for children (not just younger age ranges i.e., 18-24, but also carers at retirement age i.e. 65+).

Caregiver participation in this study was encouraged thanks to the efforts of two GPs and members of the staff from the participating practices. Participation in the out-of-hours services was achieved thanks to the efforts of a practice manager as well as members of staff from both services. This may have had an effect on the specific sample of caregivers; moreover, those volunteering participants may have had a particular interest in the study. This could have increased the possibility of not identifying caregivers with such an interest.

Questionnaires were checked both by the author and another researcher (BF). Further checks by other researchers could have increased the reliability of the results obtained.

Participants were informed that the survey was part of a doctoral research in which a student (author) was the primary responsible, moreover, the study was an independent research detached from their practice or the out-of-hours service. Caregivers' responses may have been modified if they thought staff at their practice or out-of-hours will share this information. Furthermore, the author helped encouraging prospective participants to engage in the study while trying not to provide any leading information, nevertheless his attitude and motivation towards this specific research may have shaped some of the participants' responses.

On occasions some of the respondents may have been close to each other while filing their own questionnaires. GP practices and out-of-hours services waiting rooms allowed participants to sit anywhere where spaces may be available. Even though it was encouraged in the PIS for participants to answer their own question to the best of their ability, caregivers could have potentially asked others for help when responding to their questionnaires.

6.5.6 Conclusions

Carers reported seizures and brain damage as the main harms associated with fever. This fear of fever, together with lack of understanding of temperature management, may be a reason why caregivers measured temperature frequently, provided antipyretics at low temperature levels or used non recommend methods to lower fever.

Fever was seen by most caregivers as a state of illness that needs to be treated, instead of a natural bodily response to an underlying condition. This did not seem to always be understood and children, on occasions, were wrongly treated with antipyretic therapy. Practices of alternating antipyretics, using them at the same time, and sometimes giving them at low temperature thresholds, were mentioned. The newest edition of the NICE guideline recommends the use of antipyretics to relieve “stress on the child” and not with the sole aim of reducing body temperature. Furthermore, it does not recommend using two agents (antipyretics) simultaneously but “changing to other agent if the child’s distress is not alleviated”.[29 49 54183 223]

Results from this study also highlight the importance of family, friends and health care providers’ knowledge, as caregivers based much of their understanding of measuring fever and decisions on its management on this information. In addition, consistent information should be developed for parents and caregivers based on latest guidance to reduce unnecessary referrals.

6.6 References

1. NICE. Assessment and initial management of feverish illness in children younger than 5 year. *BMJ* 2007;334(7604): 1163–1164.
2. Bruijnzeels MA, Foets M, van der Wouden JC, van den Heuvel WJ, Prins A. Everyday symptoms in childhood: occurrence and general practitioner consultation rates. *Br J Gen Pract* 1998;48(426):880-4.
3. Hay AD, Heron J, Ness A. The prevalence of symptoms and consultations in pre-school children in the Avon Longitudinal Study of Parents and Children (ALSPAC): A prospective cohort study. *Family Practice* 2005;22(4):367-74.
4. Thompson M, Mayon-White R, Harnden R, Perera R, McLeod D, and Mant D. Using vital signs to assess children with acute infections: a survey of current practice. *British Journal of General Practice* 2008;58(549):236–41.
5. Nadel S, Britto J, Booy R, Maconochie I, Habibi P, Levin M. Avoidable deficiencies in the delivery of health care to children with meningococcal disease. *Journal of Accident & Emergency Medicine* 1998;15(5):298-303.
6. Van den Bruel A, Haj-Hassan T, Thompson M, Buntinx F, Mant D. Diagnostic value of clinical features at presentation to identify serious infection in children in developed countries: a systematic review. *The Lancet*;375(9717):834-45.
7. Blumenthal I. Fever and the practice nurse: measurement and treatment. *Community Practitioner* 2000;73(3):519-21.
8. Grossman D, Keen MF, Singer M, Asher M. Current nursing practices in fever management. *Medsurg Nurs.* 1995;4(3):193-8.
9. Abdullah MA, Ashong EF, Al Habib SA, Karrar ZA, Al Jishi NM. Fever in children: diagnosis and management by nurses, medical students, doctors and parents. *Annals of tropical paediatrics* 1987;7 (3):194-99.
10. Blumenthal I. What parents think of fever. *Fam Pract* 1998;15(6):513-8.
11. Bindman A, Forrest C, Britt H, Crampton P, Majeed A. Diagnostic scope of and exposure to primary care physicians in Australia, New Zealand, and the United States: cross sectional analysis of results from three national surveys. *BMJ* 2007;334:1261.
12. Hernandez J, Heneghan C, Thompson M, Ward A, Gill P, Moscrop A, Roberts N. Parents use and interpretation of thermometry in children: a systematic review *Part of DPhil Thesis* 2012.
13. Banco L, Jayashekaramurthy S. The Ability of Mothers to Read a Thermometer. *Clinical Pediatrics* 1990;29(6):343-45.
14. Crocetti M, Moghbeli N, Serwint J. Fever phobia revisited: Have parental misconceptions about fever changed in 20 years? *Pediatrics* 2001;107 (6):1241-46.
15. Kramer MS, Naimark L, Leduc DG. Parental fever phobia and its correlates. *Pediatrics* 1985;75(6):1110-3.
16. Impicciatore P, Nannini S, Pandolfini C, Bonati M. Mother's knowledge of, attitudes toward, and management of fever in preschool children in Italy. *Prev Med* 1998;27(2):268-73.
17. Sakai R, Okumura A, Marui E, Niijima S, Shimizu T. Does fever phobia cross borders? The case of Japan. *Pediatrics International* 2011:no-no.
18. Gunher Arica S, Arica V, Onur H, Gülbayzar S, Dağ H, Obut Ö. Knowledge, attitude and response of mothers about fever in their children. *Emergency Medicine Journal* 2011.
19. Goldman RDS, Dennis. Underdosing of Acetaminophen by Parents and Emergency Department Utilization. *Pediatric Emergency Care:* 2004;20(2).
20. Li F, Lacher B, Crain, E. Acetaminophen and ibuprofen dosing by parents. *Pediatric Emergency Care* 2000;16(6).
21. McErlean MA, Bartfield JM, Kennedy DA, Gilman EA, Stram RL, Raccio-Robak N. Home antipyretic use in children brought to the emergency department. *Pediatric emergency care* 2001;17(4).
22. Linder N, Sirota L, Snapir A, Eisen I, Davidovitch N, Kaplan G, et al. Parental knowledge of the treatment of fever in children. *Isr Med Assoc J* 1999;1(3):158-60.

23. Schmitt BD. Fever phobia. Misconceptions of parents about fevers. *American Journal of Diseases of Children* 1980;134 (2):176-81.
24. Karwowska A, Nijssen-Jordan C, Johnson D, Davies HD. Parental and health care provider understanding of childhood fever: a Canadian perspective. *CJEM* 2002;4(6):394-400.
25. Kilmon CA. Parents' knowledge and practices related to fever management. *J Pediatr Health Care* 1987;1(4):173-9.
26. Crocetti M, Sabath B, Cranmer L, Gubser S, Dooley D. Knowledge and management of fever among Latino parents. *Clin Pediatr (Phila)* 2009;48(2):183-9.
27. Purssell E. Parental fever phobia and its evolutionary correlates. *Journal of Clinical Nursing* 2009;18 (2):210-18.
28. Chiappini E, Parretti A, Becherucci P, Pierattelli M, Bonsignori F, Galli L, et al. Parental and medical knowledge and management of fever in Italian pre-school children. *BMC Pediatrics* 2012;12(1):97.
29. NICE. Feverish illness in children: Assessment and initial management in children younger than 5 years (guidance), 2013.
30. Erkek N, Senel S, Sahin M, Ozgur O, Karacan C. Parents' perspectives to childhood fever: comparison of culturally diverse populations. *J Paediatr Child Health* 2010;46(10):583-7.
31. Purssell E. Treatment of fever and over-the-counter medicines. *Arch Dis Child* 2007;92(10):900-1.
32. Al-Eissa YA, al-Zamil FA, al-Sanie AM, al-Salloum AA, al-Tuwaijri HM, al-Abdali NM, et al. Home management of fever in children: rational or ritual? *Int J Clin Pract* 2000;54(3):138-42.
33. Boivin JM, Weber F, Fay R, Monin P. Management of paediatric fever: is parents' skill appropriate?. [French]. *Archives de pediatrie : organe officiel de la Societe francaise de pediatrie* 2007;14 (4):322-29.
34. Walsh A, Edwards H, Fraser J. Influences on parents' fever management: beliefs, experiences and information sources. *J Clin Nurs* 2007;16(12):2331-40.
35. Pan JSY, Shek LPC. Parental Knowledge, Practices and Fears Regarding Fever in Singapore Children - A Questionnaire Survey. *Singapore Paediatric Journal* 2003;45 (2):71-76.
36. Poirier MP, Collins EP, McGuire E. Fever phobia: a survey of caregivers of children seen in a pediatric emergency department. *Clin Pediatr (Phila)* 2010;49(6):530-4.
37. Badenoch CHaD. Evidence-based Medicine Toolkit. 2006.
38. Pope C, Ziebland S, Mays N. Qualitative research in health care. Analysing qualitative data. *Bmj*. 2000;320(7227):114-6.
39. Office HP. Personal Income Statistics Summary. In: (UK) HMsRaC, editor, 2012.
40. Rupe A, Ahlers-Schmidt CR, Wittler R. A comparison of perceptions of fever and fever phobia by ethnicity. *Clin Pediatr (Phila)* 2010;49(2):172-6.
41. Saz EU, Koturoglu G, Duyu M, Ozananar Y, Kurugol Z, Sever M. Fears of fever and fever management in Turkish families. [Turkish]. *Cocuk Enfeksiyon Dergisi* 2009;3 (4):161-64.
42. Goldman RD, Scolnik D. Underdosing of acetaminophen by parents and emergency department utilization. *Pediatr Emerg Care* 2004;20(2):89-93.
43. Sullivan JE, Farrar HC, Pharmacology tSoC, Therapeutics, Drugs Co. Fever and Antipyretic Use in Children. *Pediatrics* 2011;127(3):580-87.
44. Crocetti M, Moghbeli N, Serwint J. Fever phobia revisited: have parental misconceptions about fever changed in 20years? *Pediatrics* 2001;107:1241 - 46.
45. Kim D, Lee Y, Lee J, Jeong J, Kim J, Choi M. Perceptions and practices of fever: Survey for parents with febrile child visiting pediatric emergency department. *Annals of Emergency Medicine* 2009;Conference: American College of Emergency Physicians, ACEP 2009 Research Forum Boston, MA United States. Conference Start: 20091005 Conference End: 20091006. Conference Publication: (var.pagings). 54 (3 SUPPL. 1):S92.
46. Guyton AC, editor. *Body Temperature, Temperature Regulation and Fever*. Philadelphia., 1996.
47. Al-Mohsen AHKE. Fever in children: Parental perceptions. *Journal of the Bahrain Medical Society* 2005;17 (2):100-06.

48. Al-Abdel Jalil HK, Jumah NA, Al-Baghli AA. Mothers' knowledge, fears and self-management of fever: A cross-sectional study from the capital governorate in Kuwait. *Kuwait Medical Journal* 2007;39 (4):349-54.
49. Wright AD, Liebelt EL. Alternating antipyretics for fever reduction in children: an unfounded practice passed down to parents from pediatricians. *Clin Pediatr (Phila).* 2007;46(2):146-50.
50. Weiss J, Herskowitz L. House officer management of the febrile child. A survey. *Clin Pediatr (Phila)* 1983;22(11):766-9.
51. Demir F, Sekreter O. Knowledge, attitudes and misconceptions of primary care physicians regarding fever in children: a cross sectional study. *Ital J Pediatr* 2012;38(1):40.
52. Clarke S. Use Of Thermometers In General Practice. *BMJ: British Medical Journal* 1992;304(6832):961-63.
53. Thompson M M-WR, Harden A, Perera R, McLeod Diane and Mant D. Using vital signs to assess children with acute infections: a survey of current practice. *British Journal of General Practice* 2008(58):236-41

54. Mayoral CE, Marino RV, Rosenfeld W, Greensher J. Alternating antipyretics: is this an alternative? *Pediatrics* 2000;105(5):1009-12.

Chapter 7 Conclusion

In the final chapter of this thesis, the research findings are summarised, and their implications for clinical practice and further research are discussed. These implications will also be used to suggest components for an intervention to improve parental and carer performance of temperature measurement, fever care and knowledge of feverish illness in children.

7.1 Overall aim of the thesis in the context of existing literature

Identification and interpretation of fever in children are key skills for caregivers who have first contact of care (i.e. home, kindergarten, nursery school, primary school, elementary school). The literature review in Chapter 2 provided an overview of the importance of fever in children and parental interactions with health care providers. It also provided an understanding of NICE guideline advice on measuring temperature, as well as existing thermometers available over the counter and their accuracy. More importantly, the review reported on the epidemiological evidence of infection and mortality in children, parental assessment of acute illness and the relationship with fever incidence in children and parental detection of fever and its care. Findings highlighted that parental understanding of temperature measurement is often inaccurate, their ability to interpret signs of fever can be misleading and their capability for reading a thermometer and interpreting a temperature threshold is often poor. Moreover, there is very limited research in this area within the UK. Furthermore, this literature review showed exaggerated perceptions of harm from fever in parents, which may in turn be detrimental for child care. Four main gaps were identified in the literature and in order to shed some light on these gaps four studies were designed and undertaken by the author as follows:

7.1.1 Understanding parental and carer knowledge of temperature measurements

It was hypothesised that parents and carers may not always have or use a thermometer, and even in cases where thermometers are owned they may be unused or used incorrectly.

These hypotheses were systematically examined and presented in Chapter 3 through the findings of a systematic review and in Chapter 6 through the use of a self-administered survey questionnaire to parents and carers. These two studies also endeavoured to assess the different temperature thresholds that parents and carers think constitute a fever, and what type of thermometers they used.

7.1.2 Parental and carer knowledge, understanding and treatment of fever

It was hypothesised that parental and caregiver knowledge and care of a child's fever may not always be appropriate.

This was analysed through a systematic review in Chapter 3 and also tested with a questionnaire survey of caregivers in Chapter 6. Caregivers may interpret normal body temperatures as a fever and may have limited understanding of appropriate fever treatment.

7.1.3 Understanding parental beliefs about fever

This study hypothesis suggested that parents, in the presence of a slightly elevated temperature, exercised subjective and on occasions detrimental strategies towards health in order to decrease temperature. These hypotheses were examined in Chapter 4, through a qualitative study interviewing parents.

Exaggerated beliefs of harms have been described in the literature from very early to the most recent research.[1-3] Fear of fever causing extreme harm (death, febrile convulsions, retardation or blindness) are detrimental towards parental management of feverish illness, whereas

appropriate parental beliefs about fever may increase the likelihood of adequate management of feverish illness in children.

7.1.4 Review and investigation of the information about temperature measurements in thermometers commercially available

The hypothesis that thermometer packaging and leaflets may not provide accurate information for parents and caregivers, jeopardising their ability to correctly manage a fever, was tested in Chapter 5. This was done through a cross-sectional study to investigate the information provided by thermometer leaflets and packages, available to parents and carers on the market. This study also determined to what extent, and how this information may be useful in educating parents on how to best take a temperature measurement. It also advised to better understand the information devices provided on temperature threshold that constitutes a fever.

7.2 Summary of research findings

7.2.1 Parental knowledge and understanding of temperature measurement and fever: A systematic review

This study confirmed the hypothesis that caregivers may not always have or use a thermometer, and even if they do their use of the device is not always correct. Of the 47 studies, less than half reported the proportion of participants who owned a thermometer[2 4-21] accounting for quarter of the participants from these studies, and only ten reported participants understood how to correctly use a thermometer.[4 6 7 9 11 17-19 21 22] Parental management of fever was described in most studies with the use of antipyretic medication as the most common treatment to reduce body temperature in children, followed by sponging as

the second most used treatment to reduce body temperature in children confirming the hypothesis that their knowledge and care of fever was not always appropriate.

Parental knowledge about normal body temperature and fever in children was poor, mild fever was misclassified by many as high. Parents' understanding of what actually constitutes fever ranged widely: some participants considered fever to be equal or below 37 °C, whilst others considered a fever to be 38 °C to 38.9 °C. Parents had qualitative concerns about fever even at mild temperatures. Consequences from fever such as brain damage, febrile convulsions and death were often mentioned irrespective of parental education or socio-economic status. Increased use of antipyretics to reduce fever, waking sleeping febrile children and sponging were common practices among parents.

7.2.2 Understanding parental knowledge, beliefs and practices regarding measurement of temperature and management of fever in children under five years: A focus group interview

This study confirmed the hypothesis that parents, in response to slightly elevated temperature, exercised subjective and, at times, detrimental strategies towards the child's health. Parental management included antipyretics, in most cases, and often parents combined two antipyretics simultaneously (paracetamol and ibuprofen), as they perceived these drugs combined would control fever better. Importantly, parents mentioned administering the maximum recommended antipyretic dose to reduce fever. Reducing layers of clothing and giving cold drinks or popsicles were the most typical physical methods used together with the use of sponging. A possible reason for this is that many parents considered temperatures of 38 °C and above as high fever, nevertheless some parents waited until their child's temperature reached 40 °C before seeking referral.

As shown in Chapter 3, parental knowledge of thresholds did not seem to be always accurate. Specific temperature thresholds were not suggested; nonetheless, a lower threshold of 37.5 °C was suggested and these temperature ranged substantially (by 3.5 °C, 37.5 °C to 41 °C). Parents seemed to be worried about the height or length of fever, and both variables increased concern about the possible consequences and its seriousness.

Participants reported they were concerned when their children had a fever as they thought it could have an effect on their children, such as reducing the functioning of major organs (brain, kidney, liver), they also suggested that fever could be due to serious conditions such as meningitis, tonsillitis or chickenpox. However, having older children seemed to decrease parental anxiety, but this was not the case in parents who had experienced more serious sequalae with an accompanying fever.

GPs were mentioned as the main healthcare staff they would contact in the case of fever, paediatricians were also mentioned as well as healthcare staff at the practices. Participants also suggested out-of-hours services and A&E as places to take a feverish child, NHS advice via NHS direct (now decommissioned) or 111 number (NHS emergency and urgent care services). However, this was contrasted by some parents expressing concerns about contradictory advice on management given by some GPs. All parents considered they needed more information about fever and its management, and wished to be given this information early on in a child's life. Parents wanted to know more specific information and how to identify signs of "fevers" that precede more serious conditions.

7.2.3 Assessment of different thermometers available to parents and carers: A cross-sectional study of thermometers

Almost all thermometer leaflets in this study indicated how to read the measurement, and over half contained images showing how to place the thermometer in different body sites.

This study, however, corroborated the hypothesis that information does not provide accurate knowledge for parents and caregivers. Thermometer information was heterogeneous in instructions and advice presented, the amount of data and level of explanation; thus in some instances accompanying information was insufficient to understand how to correctly use the device. Furthermore, leaflet design, its length and the information contained, varied greatly from device to device. Also some thermometers did not include leaflets, and had all the information incorporated in the packaging, which is possibly at greater risk of being discarded. Some devices provided information as detailed books, however, the bulk of this was an explanation of the information presented as translation into several languages.

Fever thresholds were mentioned in less than half of the thermometer leaflets and packaging, and just above 1 in 10 matched NICE's fever definition.[23 24] Moreover, not a single leaflet suggested the use of all thermometer types recommended by NICE, and just over half of the thermometers suggested the use of non-recommended sites such as oral and rectal measurements. No discrepancies were raised even in leaflets of devices from which relatively low literature describing evidence of accuracy existed, e.g. pacifiers or temporal thermometers.[25-27]

Seeking healthcare advice was mentioned in over a third of thermometer leaflets. This is important, as this information may promote unnecessary referral. Furthermore, about 1 in 10 thermometers also included provision of management information, however, techniques not recommended by NICE such sponging as were suggested. More expensive thermometers did not seem to provide more or superior information about when to seek advice from a healthcare professional, what to do when a child was febrile or what clinical features to assess when fever is suspected.

7.2.4 Chapter 6 - Assessment of parents' and carers' knowledge of temperature measurement and management of fever in children under five years: A survey

The hypothesis that parental and caregiver knowledge and care of a child's fever may not always be appropriate was confirmed in this study, as well as in Chapters 3 and 4. Moreover, about one fourth of participants considered a temperature threshold of 37 to 37.9 °C to be high. Extremely serious consequences such as brain damage or death from fever were frequently described by caregivers in the survey, also confirming findings from Chapters 3 and 4. This survey supported again findings from Chapters 3 and 4, suggesting that caregivers' management of fever was not always adequate, with almost a third of them treating children at low temperature thresholds. A small number of participants administrated antipyretics under two hours, and more than one in 10 would administer antipyretic therapy every 6 or more hours, with about one fourth suggesting administering medication either too frequently or too unfrequently.[28 29]

As suggested in Chapters 3 and 4, caregivers used methods to manage fever not recommended by NICE such as bathing, sponging or waking children unnecessarily at night; however, the majority of children were well hydrated when they had a feverish illness. Most caregivers in this study suggested they were worried or very worried and a greater number of carers aged 18 to 24 years reported being very worried, which may confirm findings from Chapter 4 suggesting older parents have lower levels of anxiety.

The survey also showed that over one in 10 of those thermometers used by parents were not recommended by the NICE guideline (forehead chemical), and a small number of participants reported to still be using mercury-in-glass thermometers. Moreover, a comment from the questionnaire highlighted "discrepancy" when reading a thermometer in different body parts, a finding that was previously recorded by most parents in Chapter 4.

Another interesting finding showed that over half of the participants' answers reported thermometer instructions as the most usual way for them to learn how to use a thermometer. This finding complements the educational importance of thermometers

suggested in Chapter 5.

7.3 Implications of research findings for clinical practice and caregivers – Developing interventions to improve parental and carer performance on temperature measurement, fever care and knowledge of feverish illness in children

The research presented in this thesis provides evidence about caregivers' management for a feverish child. It suggests that the methods they use for this care are not always adequate, the specific knowledge they have of fever is not always correct and how carers' specific beliefs may play a part on the way they deal with a fever. Overall, NICE guidance recommendations for caregivers were not always followed.[23 24] Previous research has highlighted some of this thesis' findings;[2 30] however, studies that try to incorporate this evidence in a systematic way, together with qualitative and quantitative research has not yet been done, moreover, this research provides current UK evidence at primary care level.

The NICE clinical guidance provides simple advice for home care, advising parents and carers how to detect signs of dehydration (e.g. absence of tears, sunken fontanelle, poor overall appearance etc.), encouraging subsequent offering of fluids regularly to the child, identifying a non-blanching rash or checking the child during the night. The initial stage for the assessment of a child involves caregivers' global assessment of the severity of an illness at home, compromises observing the child's level of activity (such as alertness and response to social interaction), and colour of the skin (e.g. pallor, cyanosis).[23 31 32] Caregivers should perform this assessment together with the assessment of temperature. In this respect the NICE

guideline recognised children younger than 3 months with a temperature of 38 °C or above are in a high risk group for serious illness, and children between 3 to 6 months with temperatures of 39 °C or above are at least in an intermediate risk group for serious illness. Furthermore, their appreciation of the existence of fever could be aided by NICE recommended thermometers (electronic or chemical dot thermometer in the axilla or infra-red thermometer at the eardrum). When caregivers perceive conditions matching the signs mentioned above, they may be able to appropriately seek further care when necessary, or, whether they judge these signs are not an indication of a more serious illness, treat the child at home adequately using antipyretic and non-antipyretic management.[33 34 3535 36 34 37]

This thesis identified caregivers receive contradictory advice about fever management, better informed healthcare professionals may therefore be key providers of information and aid decision-making.[38] Furthermore, this study highlighted that manufacturers did not incorporate any recommendations from NICE. Key recommendations on the identification of serious illness and on the care of fever following NICE recommendations could easily be incorporated into thermometer information.

The author suggests that non-specialist care services (GP practices, out-of-hours departments, walk-in clinics, minor injury units, A&E units, NHS telephone lines and other services where caregivers get information from) should be provided with up to date advice from NICE. Basic recommendations should be placed in visible and strategic places where healthcare staff can see them on a daily basis. Regular staff updates may also include briefings about the guideline. More importantly, the author suggests that caregivers be provided with a very brief and basic leaflet highlighting advice for home care, as soon as they have a child, or care for one. Posters with this information in NHS trusts may be helpful. Thermometer manufacturers could also include a similar leaflet, or add these recommendations together with the information they already provide.

Table 7.1 presents NICE guidance information. Although this has not been validated, it is an example of the sort of information that could be given to carers for children, or included in thermometer information.

Table 7.1 – NICE guideline advice for feverish illness in children under five years

Children and fever
Only in a small number of cases your child's fever may not improve or the child's health worsen. In most cases it will be a temporary mild condition.
Your child's care is your decision
You have the right to be fully informed about your child circumstances in a way you can understand and have a decision during the progression of his/her treatment.
Working out the cause of fever
If you talk to a healthcare professional on the phone it may be helpful to decide whether your child would be better cared at home, may require a face to face visit with a healthcare professional, whether the situation requires urgent advice.
Your healthcare professional should measure your child's temperature, pulse and breathing, and any signs of dehydration.
If after full examination your healthcare professional cannot find a reason for your child's fever, antibiotic medication should not be prescribed.
Sometimes your healthcare professional may decide your child may need a follow-up appointment.
Measuring your child's fever
Fever in children under 6 months can be a sign of serious illness or infection.
Temperature of 38 °C or over in a baby 3 months or younger may require further tests.
Temperature of 39 °C or over in a baby between 3 and 6 months may require further tests.
You should measure your child's temperature with a (electronic or chemical dot) thermometer under the arm or (infra-red tympanic thermometer) in the ear.
Caring for your child at home
Look for signs of dehydration in your child such as: dry mouth, absence of tears, sunken eyes, poor overall appearance.
Check your child during the night.
Keep your child away from school or nursery while they have a fever (and notify of your child's absence).
Offer your child regular drinks (milk is best if breastfeeding) if he or she is dehydrated.
Do not over or under dress your child.
Do not sponge your child with water.
Paracetamol and ibuprofen can be used to reduce your child's fever and to make him/her feel more comfortable as long as he/she appears distressed, not just to reduce temperature.
Paracetamol and ibuprofen should not be administered at the time but if one medicine does not help you, you may consider using the other.
Do not administer paracetamol and ibuprofen simultaneously.
Following contact with a healthcare professional, when you are looking for a child at home, you should seek further advice if:
The child has a fit.
The child develops a rash that is unusual or does not disappear with pressure.
You feel the child is less well than when you previously sought advice.
If you are more worried than when you previously sought advice.
The fever lasts longer than 5 days.
You are distressed, or concerned you are unable to look after the child.

7.4 Implications of research findings for future research

The findings from the research presented in this thesis suggests several areas for further study. Firstly, to explore carers knowledge of temperature measurement and fever management in different settings. Studies included in the systematic review were mainly in hospitals and clinics. In addition, the survey questionnaire was only carried out in GP practices and out-of-hours departments. This research could therefore be performed looking at populations from both clinical and non-clinical settings, generalising findings to a wider population. Moreover, further surveys could collect information on socio-demographic data (age, sex, number of children and their age, caregivers' employment and financial status) and data related to fever and temperature measurement. This data could be further classified into sections such as fever knowledge, management and the use of thermometers. Thus, the questionnaire could be a complete tool to understand caregivers' knowledge of temperature measurement and fever care. Furthermore, the use of surveys that include questions previously used in other surveys[1 39 40] would be important to compare newer data with previous findings.

Moreover, this thesis found some parents believed the advice they were given was, on occasions, contradictory. Very few studies have looked at practitioner knowledge of thermometer use[41 42] and fever management,[43] newer surveys with more specific questions relating to the NICE guidance could be administered to GPs and other healthcare staff in order to confirm or refute these findings.

A follow-up prospective study could be performed to understand the association of *fever knowledge and primary care admission patterns*. This study may involve caregivers filling up a complete and comprehensive questionnaire about fever knowledge and its care. Questionnaires would then be assigned a score and caregivers admission patterns can be followed through their NHS numbers. This may help understand whether there is a

relationship between fever knowledge and primary care admission patterns (i.e. a greater knowledge score related to a decreased admission in primary care). A further study, would therefore involve a *randomised control trial (RCT) of a fever education intervention and its effects on primary care admission patterns.*

A second area of research could look into thermometer information. The number of thermometers, and the subsequent analysis of their included information could be improved by increasing the number of thermometers in the study, thus generalising and confirming the findings of the study in this thesis. Furthermore, the use of thermometer information including NICE guideline recommendations, and their relation to caregiver understanding of fever management and temperature measurement could be investigated. Studies from this thesis did not look into thermometers accuracy. Recent research highlights data on thermometer effectiveness and accuracy of devices,[27 44] further studies could understand whether thermometer accuracy has an impact on caregiver treatment and referral. Moreover, further studies may look into cost[2] in order to understand whether cost has an influence on caregivers choice of device.

A randomised controlled trial providing *thermometer information based on NICE guideline advice and knowledge of fever* could be performed. Caregivers would be randomised to a thermometer with a comprehensive leaflet (containing advice with correct temperature measurement techniques, and appropriate home management care according to NICE guidance) and a control group given the same thermometer containing a regular leaflet. Additional web information could also be provided to the intervention group. Outcomes would assess whether the intervention groups' understanding and home management differs

from the control group (i.e. the intervention group has more, and appropriate, knowledge about temperature measurement and home management of fever).

A third area for research that this thesis highlighted is the high use of antipyretics to treat children. Carers did not understand that risks of lowering fever included delayed identification of underlying diagnosis, appropriate treatment or drug toxicity.[45] The use of combined therapies is mentioned in the NICE guideline[23] "only consider alternating these agents if the distress persists or recurs before the next dose is due". Studies looking specifically at caregiver's use of antipyretics could be useful to understand the extent of these practices. Studies in different settings may be able to understand whether these findings could be generalised to caregivers attending other settings such as in-hours general practice, out-of-hours centres or A&E.

A *focus group interview of caregivers' use of antipyretics* may also be useful to understand what drives carers to use therapy and why they may over or under use antipyretics, as well as their specific antipyretic choice. This study may be the basis for a further and more in depth questionnaire about specific caregivers' use of antipyretic (types of antipyretics used, administration frequency, dosage (milligrams per day) or alternation of different types of antipyretics).

7.5 Final conclusions

In many cases demand on emergency pediatric admissions[46] and A&E departments[47] arises from children with mild self-limiting illnesses. Throughout this thesis it has been shown that caregivers' knowledge of fever and its care is suboptimal. Their clinical judgment during an illness may not be always correct[48 49] and this can be influenced due to overestimating the seriousness of acute illnesses,[50] lack knowledge of fever and its management[2 30 39] and lack of understanding of health information.[51]

Simple steps towards increasing caregiver's knowledge of fever could prove useful.[33 34 3535 36] Suggestions to improve the management of fever within primary care[41 43 52 53-55] and pharmaceutical industry may also be useful. Thus, the author proposes simple pragmatic interventions should be developed for caregivers, GPs and allied health professionals, and the pharmaceutical industry that aim to improve the care of fever in children and reduce unnecessary referrals.

7.5.1 Summary of recommendations

Managing a child's fever starts at home, and therefore it is clear from the findings from this thesis that parents and carers should be provided with the means to be informed on how to best care for their children.

Throughout this thesis it has been shown that elevated temperatures prompt carers to think of harms, with concerns of uncontrolled fever rising to dangerous temperatures (see Chapters 3, 4 and 6). Carers need to understand the importance that fever plays as a defence mechanism in a child's immune system,[56] thus the likelihood of serious consequences as brain damage or fits are, in the majority of cases, minimal. In terms of assessing temperature, emphasis for carers needs to shift to being attentive to signs and symptoms (see Table 7.1), together with

the temperature observed in a recommended thermometer, rather than only focusing on the number shown by the device.

When informing caregivers it should be emphasised that the treatment goal for antipyretic medication should be the child's comfort rather than bringing the temperature down to normal levels.[45] The use of external cooling measures such as tepid sponge baths may temporarily decrease body temperature, however, it won't increase a child's comfort.[57 58]

7.5.2 Information and its delivery

A) Parents and carers

Primary care resources can be used to produce pamphlets with a clear and simple explanation of what a fever is for caregivers. This explanation should include information that helps demystify self-limiting fevers.

Identifying signs and symptoms of conditions that may require further attention should be described within provided information (see Table 7.1), as well as asserting the importance to own guideline recommended devices (i.e. digital thermometers) and use them in suggested body sites. This information could be provided in a variety of formats and in various venues to improve uptake such as baby or pediatric clinics, during general practitioners consultations or community initiatives such as council activities for parents and caregivers by qualified healthcare staff.

Furthermore, government initiatives need to be developed and aimed to everyone who cares, or can potentially care, for a child. These initiatives should reflect NICE guidelines, including:

- When to seek for further advice

- Recognition and prevention of dehydration

- How to look for and identify a non-blanching rush

- Checking the child during the night

- How to keep the child cool and comfortable without sponging

- The appropriate, effective and safe use of antipyretics

- Keeping the child away from school or nursery while they have a fever

Guidance needs to be provided as much in primary care as outside of healthcare (i.e. as in previous NHS campaigns (marketed on buses or pamphlets) showing NHS users when is necessary to visit an A&E department).

It is clear that many children with a fever can be successfully cared for at home, but information should ensure that parents and carers understand what to do in the case a fever appears and when to look for further assistance.

B) Allied health professionals in primary care

The NICE guideline provides recommendations for non-pediatric practitioners on how to manage a feverish illness by remote assessment (i.e. when a phone consultation identifies a number of symptoms that may identify a serious bacterial infection that may need urgent face to face assessment). Regular NICE guideline staff advice updates should be provided on regular basis at practice level. This may include a care pathway for feverish illness in

children, temperature measurement advice as well as advice recognising and evaluating signs of a feverish illness and its management.

The Royal College of Nursing has prepared a good practice guidance[59] for nurses working with infants, children and young people based on the NICE guideline. Nurses and other frontline staff may acquire a more in depth knowledge of fever according to NICE recommendations. They could also provide parents and caregivers with advice about the home management of feverish illness (i.e. NICE home advice and when to seek for further advice), or the interpretation of fever (i.e. correct use of thermometers) in a way that can be understood and easily implemented. In addition, medication information should be a completely clear, well written and evidence-based text.

C) Pharmaceutical industry

Government initiatives based on the guideline may prompt pharmaceutical companies that produce thermometers or devices to prioritise the production of NICE recommended thermometers (or comply with another recognised evidence-based guidance).

Companies producing thermometers should include a basic additional leaflet (or table included within their current leaflet). Such a leaflet could have a substantial impact on parents and carers understanding of fever management and could be easily developed, implemented and incorporated into legislation. In the first instance this could be done through voluntary agreements to speed uptake.

An intervention can be theorized by providing caregivers with evidence-based information via healthcare providers. Since parents go to the GPs this information can be made available

through practices. Another way, will be providing this information through the thermometer packaging via legislation. In order to see whether this intervention works the intervention can be compared with standard care. However, if there is a reduction on the number of attendances through the intervention, some children could also get seriously ill. This may occur as children illnesses may not be identified. Thus, the number of seriously ill children in each intervention, as well as the cost of providing and disseminating this information can be compared. A type of study that can be performed is a cluster randomised controlled trial having in one study arm the intervention, and in the other arm standard care; however, a drawback of this test is that it may not have a lot of power and need very special statistical methods to compare the outcome.

7.6 References

1. Schmitt B. Fever phobia: misconceptions of parents about fever. *Am J Dis Child* 1980;134:176 - 81.
2. Gunher Arica S, Arica V, Onur H, Gülbayzar S, Dağ H, Obut Ö. Knowledge, attitude and response of mothers about fever in their children. *Emergency Medicine Journal* 2011.
3. Chiappini E, Parretti A, Becherucci P, Pierattelli M, Bonsignori F, Galli L, et al. Parental and medical knowledge and management of fever in Italian pre-school children. *BMC Pediatrics* 2012;12(1):97.
4. Abdullah MA, Ashong EF, Al Habib SA, Karrar ZA, Al Jishi NM. Fever in children: diagnosis and management by nurses, medical students, doctors and parents. *Annals of tropical paediatrics* 1987;7 (3):194-99.
5. Al-Mohsen AHKE. Fever in children: Parental perceptions. *Journal of the Bahrain Medical Society* 2005;17 (2):100-06.
6. Erkek N, Senel S, Sahin M, Ozgur O, Karacan C. Parents' perspectives to childhood fever: comparison of culturally diverse populations. *J Paediatr Child Health* 2010;46(10):583-7.
7. Moraga MFJ, Horwitz ZB, Romero SC. Fever phobia: Parents' knowledge and attitude towards fever. [Spanish]. *Revista chilena de pediatria* 2007;78 (2):160-64.
8. Pan JSY, Shek LPC. Parental Knowledge, Practices and Fears Regarding Fever in Singapore Children - A Questionnaire Survey. *Singapore Paediatric Journal* 2003;45 (2):71-76.
9. Porter RS, Wenger FG. Diagnosis and treatment of pediatric fever by caretakers. *Journal of Emergency Medicine* 2000;19 (1):1-4.
10. Saz EU, Koturoglu G, Duyu M, Ozananar Y, Kurugol Z, Sever M. Fears of fever and fever management in Turkish families. [Turkish]. *Cocuk Enfeksiyon Dergisi* 2009;3 (4):161-64.
11. Taveras EM, Durousseau S, Flores G. Parents' beliefs and practices regarding childhood fever: a study of a multiethnic and socioeconomically diverse sample of parents. *Pediatr Emerg Care* 2004;20(9):579-87.
12. Karwowska A, Nijssen-Jordan C, Johnson D, Davies HD. Parental and health care provider understanding of childhood fever: a Canadian perspective. *CJEM* 2002;4(6):394-400.
13. Sunter AT, Dundar C, Agac R, Uysal S, Gurses N. Knowledge and behaviors of mothers about fever. [Turkish]. *Ondokuz Mayis Universitesi Tip Dergisi* 1997;14 (2):106-11.
14. Fletcher JL, Jr., Creten D. Perceptions of fever among adults in a family practice setting. *J Fam Pract* 1986;22(5):427-30.
15. Kilmon CA. Parents' knowledge and practices related to fever management. *J Pediatr Health Care* 1987;1(4):173-9.
16. Al-Eissa YA, al-Zamil FA, al-Sanie AM, al-Salloum AA, al-Tuwaijri HM, al-Abdali NM, et al. Home management of fever in children: rational or ritual? *Int J Clin Pract* 2000;54(3):138-42.
17. Kurugol NZ, Tutuncuoglu S, Tekgul H. The family attitudes towards febrile convulsions. *Indian J Pediatr* 1995;62(1):69-75.
18. Crocetti M, Sabath B, Cranmer L, Gubser S, Dooley D. Knowledge and management of fever among Latino parents. *Clin Pediatr (Phila)* 2009;48(2):183-9.
19. Blumenthal I. What parents think of fever. *Fam Pract* 1998;15(6):513-8.
20. Schwartz N, Guendelman S, English P. Thermometer use among Mexican immigrant mothers in California. *Soc Sci Med* 1997;45(9):1315-23.
21. Stagnara J, Vermont J, Durr F, Ferradji K, Mege L, Duquesne A, et al. [Parents' attitudes towards childhood fever. A cross-sectional survey in the Lyon metropolitan area (202 cases)]. *Presse Med* 2005;34(16 Pt 1):1129-36.
22. Al-Abdel Jalil HK, Jumah NA, Al-Baghli AA. Mothers' knowledge, fears and self-management of fever: A cross-sectional study from the capital governorate in Kuwait. *Kuwait Medical Journal* 2007;39 (4):349-54.
23. NICE. Feverish illness in children: Assessment and initial management in children younger than 5 years (guidance), 2013.

24. NICE. Assessment and initial management of feverish illness in children younger than 5 year. *BMJ* 2007;334(7604): 1163–1164.
25. Greenes DS, Fleisher GR. Accuracy of a Noninvasive Temporal Artery Thermometer for Use in Infants. *Arch Pediatr Adolesc Med* 2001;155(3):376-81.
26. Callanan D. Detecting Fever in Young Infants: Reliability of Perceived, Pacifier, and Temporal Artery Temperatures in Infants Younger Than 3 Months of Age. *Pediatric emergency care* 2003;19(4):240-43.
27. Laird C CG, Davie A and Stevenson G What is the clinical and cost effectiveness of temporal artery thermometers compared with infrared in-ear thermometers for temperature measurement in routine practice. In: Scotland HI, editor, 2013.
28. Li F, Lacher B, Crain, E. Acetaminophen and ibuprofen dosing by parents. *Pediatric Emergency Care* 2000;16(6).
29. Goldman RD, Scolnik D. Underdosing of acetaminophen by parents and emergency department utilization. *Pediatr Emerg Care* 2004;20(2):89-93.
30. Schmitt BD. Fever phobia. Misconceptions of parents about fevers. *American Journal of Diseases of Children* 1980;134 (2):176-81.
31. Hewson PH, Poulakis Z, Jarman F, Kerr JF, McMaster D, Goodge J, et al. Clinical markers of serious illness in young infants: A multicentre follow-up study. *Journal of Paediatrics and Child Health* 2000;36(3):221-25.
32. Van den Bruel A, Bruyninckx R, Vermeire E, Aerssens P, Aertgeerts B, Buntinx F. Signs and symptoms in children with a serious infection: a qualitative study. *BMC Family Practice* 2005;6(1):36.
33. O'Neill-Murphy K, Liebman M, Barnsteiner JH. Fever education: does it reduce parent fever anxiety? *Pediatr Emerg Care* 2001;17(1):47-51.
34. Henderson DP, Thomas DO, Murphy KA, Liebman M. Fever care: Does nursing instruction make a difference? *Journal of Emergency Nursing* 1995;21(5):461-63.
35. Broome ME, Dokken DL, Broome CD, Woodring B, Stegelman MF. A study of parent/grandparent education for managing a febrile illness using the CALM approach. *J Pediatr Health Care* 2003;17(4):176-83.
36. Sarrell M, Kahan E. Impact of a single-session education program on parental knowledge of and approach to childhood fever. *Patient Educ Couns* 2003;51(1):59-63.
37. Casey R, McMahon F, McCormick MC, Pasquariello PS, Jr., Zavod W, King FH, Jr. Fever therapy: an educational intervention for parents. *Pediatrics* 1984;73(5):600-5.
38. Huang MC, Shih CJ. Effects of fever education on changing parental concepts and management of fever in childhood. [Chinese]. *Hu li za zhi The journal of nursing* 2004;51 (6):34-38.
39. Crocetti M, Moghbeli N, Serwint J. Fever phobia revisited: Have parental misconceptions about fever changed in 20 years? *Pediatrics* 2001;107 (6):1241-46.
40. Sakai R, Okumura A, Marui E, Niijima S, Shimizu T. Does fever phobia cross borders? The case of Japan. *Pediatrics International* 2011:no-no.
41. Clarke S. Use Of Thermometers In General Practice. *BMJ: British Medical Journal* 1992;304(6832):961-63.
42. Thompson M M-WR, Harden A, Perera R, McLeod Diane and Mant D. Using vital signs to assess children with acute infections: a survey of current practice. *British Journal of General Practice* 2008(58):236-41

43. Demir F, Sekreter O. Knowledge, attitudes and misconceptions of primary care physicians regarding fever in children: a cross sectional study. *Ital J Pediatr* 2012;38(1):40.
44. Rubia-Rubia J, Arias A, Sierra A, Aguirre-Jaime A. Measurement of body temperature in adult patients: Comparative study of accuracy, reliability and validity of different devices. *International Journal of Nursing Studies* 2011;48(7):872-80.
45. Sullivan JE, Farrar HC, Pharmacology tSoC, Therapeutics, Drugs Co. Fever and Antipyretic Use in Children. *Pediatrics* 2011;127(3):580-87.

46. Stewart M, Werneke U, MacFaul R, Taylor-Meek J, Smith HE, Smith IJ. Medical and social factors associated with the admission and discharge of acutely ill children. *Archives of Disease in Childhood* 1998;79(3):219-24.
47. Armon K, Stephenson T, Gabriel V, MacFaul R, Eccleston P, Werneke U, et al. Determining the common medical presenting problems to an accident and emergency department. *Archives of Disease in Childhood* 2001;84(5):390-92.
48. McCarthy P, Freudigman K, Cicchetti D, Mayes L, Lopez Benitez J, Salloum S, et al. The mother-child interaction and clinical judgment during acute pediatric illnesses. *The Journal of Pediatrics* 2000;136(6):809-17.
49. McCarthy PL, Sznajderman SD, Lustman-Findling K, Baron MA, Fink HD, Czarkowskl N, et al. Mothers' clinical judgment: A randomized trial of the Acute Illness Observation Scales. *The Journal of Pediatrics* 1990;116(2):200-06.
50. Bauchner H, McCarthy PL, SZznajderman SD, Baron MA, Fink HD, Forsythb, et al. Do Mothers Overestimate the Seriousness of Their Infants' Acute Illnesses? *Journal of Developmental & Behavioral Pediatrics* 1987;8(5):255-59.
51. Kumar D, Sanders L, Perrin EM, Lokker N, Patterson B, Gunn V, et al. Parental Understanding of Infant Health Information: Health Literacy, Numeracy, and the Parental Health Literacy Activities Test (PHLAT). *Academic Pediatrics* 2010;10(5):309-16.
52. Thompson M, Mayon-White R, Harnden A, Perera R, McLeod D, Mant D. Using vital signs to assess children with acute infections: a survey of current practice. *British Journal of General Practice* 2008;58(549):236-41.
53. Walsh AM, Edwards HE, Courtney MD, Wilson JE, Monaghan SJ. Fever management: paediatric nurses' knowledge, attitudes and influencing factors. *Journal of Advanced Nursing* 2005;49(5):453-64.
54. Chung Y-S, Kim J-S. Pediatric Nurses' Knowledge and Attitudes toward Childhood Fever. *J Korean Acad Child Health Nurs* 2009;15(2):171-81.
55. Edwards H, Walsh A, Courtney M, Monaghan S, Wilson J, Young J. Improving paediatric nurses' knowledge and attitudes in childhood fever management. *Journal of Advanced Nursing* 2007;57(3):257-69.
56. Watts R, Robertson J, Thomas G. Nursing management of fever in children: a systematic review. *Int J Nurs Pract* 2003;9(1):S1-8.
57. El-Radhi ASM. Why is the evidence not affecting the practice of fever management? *Archives of Disease in Childhood* 2008;93(11):918-20.
58. Greisman LA, Mackowiak PA. Fever: beneficial and detrimental effects of antipyretics. *Current Opinion in Infectious Diseases* 2002;15(3):241-45.
59. Nursing RCo. Caring for children with fever RCN good practice guidance for nurses working with infants, children and young people: Royal Collegue of Nursing, 2013.

Appendices

Appendix Chapter 2

2.1 Use of thermometer in primary care

Cinahl

S4 S1 and S2 and S3

Search modes - Boolean/Phrase 37 Articles

Interface - EBSCOhost
Search Screen - Advanced Search
Database - CINAHL

S3 ((primary care or General practi* or family practi* or family physician* or primary health care* or primary healthcare* or family doctor* or "out-of-hours" or office visit*)) or ((primary practice or district nurses or community pharmacist or physiotherapist or health visitor or community nurse or practice nurse or community*))

Search modes - Boolean/Phrase

Interface - EBSCOhost
Search Screen - Advanced Search
Database - CINAHL

S2 thermomet* or (temperature and measure*)

Search modes - Boolean/Phrase

Interface - EBSCOhost
Search Screen - Advanced Search
Database - CINAHL

S1 (infant* or infancy or newborn* or baby or babies or neonat* or preterm* or prematur* or postmatur* or child* or schoolchild* or scholl age or preschool* or kid or kids or toddler* or boy* or girl* or minors or pubesc* or preoubescen* or paediatric* or paediatric* or peadiatric* or nursery school* or kindergart* or primary school* or secondary school* or elementary school*)

Search modes - Boolean/Phrase

Embase

1

(infant* or infant * or infancy or newborn * or baby * or babies or neonate * or preterm * or premature * or postmature * or child * or schoolchild * or school age * or preschool * or kid or kids or toddler * or Boy * or girl * pubescent * or prepubescent * or paediatric * or nursery school * or kinderman * or primary school * or secondary school * or elementary school).mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer]

1110627 Advanced

2

(thermomet* or (temperature and measure*)).mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer]

88289 Advanced

16

(primary care or General practi* or family practi* or family physician* or primary health care* or primary healthcare* or family doctor* or "out-of-hours" or office visit*).mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer]

203327 Advanced

17

(primary practice or district nurses or community pharmacist or physiotherapist or health visitor or community nurse or practice nurse or community*).mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer]

307077 Advanced

33

16 or 17

486692 Advanced

34

1 and 2 and 33

113 Advanced

2.2 What methods do parents use in the assessment of temperature in children: a review

Cinahl

S12 S9 and S10 and S11

Search modes - Boolean/Phrase

Interface - EBSCOhost
Search Screen - Advanced Search
Database - CINAHL 153 studies

S11 Parent* Or Mother* OR Father* Or Stepparent* Or Guardian* OR Surrogate mother* OR Single Parent*

Search modes - Boolean/Phrase

Interface - EBSCOhost
Search Screen - Advanced Search
Database - CINAHL

S10 Thermomet* or (Temperature and Measure*) OR (temperature AND Assessment) OR (Fever AND Palpat*) OR (Fever AND Touch*) AND (Temperature AND Palpat*)

Search modes - Boolean/Phrase

Interface - EBSCOhost
Search Screen - Advanced Search
Database - CINAHL

S9 (infant* or infancy or newborn* or baby or babies or neonat* or preterm* or prematur* or postmatur* or child* or schoolchild* or scholl age or preschool* or kid or kids or toddler* or boy* or girl* or minors or pubesc* or preoubescen* or paediatric* or paediatric* or peadiatric* or nursery school* or kindergart* or primary school* or secondary school* or elementary school*)

Search modes - Boolean/Phrase

Embase

26

(infant* or infant * or infancy or newborn * or baby * or babies or neonate * or preterm * or premature * or postmature * or child * or schoolchild * or school age * or preschool * or kid or kids or toddler * or Boy * or girl * pubescent * or prepubescent * or paediatric * or nursery school * or kinderman * or primary school * or secondary school * or elementary school).mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer]

1110627 Advanced

27

((thermomet* or (temperature and measure*) or (temperature and Assessment) or (Fever and Palpat*) or (Fever and Touch*)) and (Temperature and Palpat*)).mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer]

119 Advanced

28

(Parent* or Parenthood* or Step-Parent* or Step Parent* or Stepparent* or mother* or father* or surrogate mother* or single parent* or Guardian*).mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer]

437468 Advanced

29

26 and 27 and 28

7 Advanced

Pubmed

#7Search #1 AND #6 AND #5 10:29:08 1

#1 Search Parent* OR Parenthood* OR Step-Parent* OR Step Parent* OR Stepparent* OR mother* OR father* OR surrogate mother* OR single parent* OR Guardian* 10:27:53 433844

#6 Search baby OR infant* OR infant* OR infancy OR newborn* OR baby * OR babies OR neonate* OR preterm* OR premature* OR postmature* OR child* OR schoolchild* OR school age* OR preschool*or kid OR kids OR toddler* OR Boy* OR girl* OR Minors[MeSH] OR minors* pubescent* OR prepubescent* OR Paediatrics[MeSH] OR paediatric* OR paediatric* OR paediatric* OR Schools[MeSH] OR nursery school* OR kinderman* OR primary school* OR secondary school* OR elementary school 10:27:17 184105

#5 Search Searchthermomet* OR (temperature AND measure*) OR (temperature AND Assessment) OR (Fever AND Palpat*) OR (Fever AND Touch*) AND (Temperature AND Palpat*) 10:26:14 80

Embase

1

(Parent* or Mother* or Father* or Stepparent* or Guardian*).mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer]

2

(Thermomet* or (Temperature and Measure*) or (temperature and Assessment)).mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer]

3

1 and 2

1434 Advanced

Cinahl

S3: S2 and S1

(184)

S2 Thermomet* or (Temperature and Measure*) OR (temperature AND Assessment)

S1 Parent* Or Mother* OR Father* Or Stepparent* Or Guardian*

Medline

#1 Search (Parent* OR Mother* OR Father* OR Stepparent* OR Guardian*) AND (Thermomet* OR (Temperature and Measure*) OR (temperature AND Assessment)) 11:39:58 309

#12 Search #3 AND #10 AND #11 09:23:54 97

#11 Search child* OR baby OR infant* OR toddler* OR school* OR newborn* OR infant* 09:21:54 3705029

#10 Search "primary care" OR General practi* Or family practi* OR family physician* Or primary health care* OR primary healthcare* OR family doctor* OR "out-of-hours" OR "office visits" 09:19:11 189623

#9 Search #8 AND #7 09:16:27 1 #8 Search underuse* OR lower use* OR Misuse 09:15:55 13775 #7 Search #3 AND #4 09:14:07 3737 #6 Select 20 document(s) 09:12:09 20

#5 Search #1 AND #3 AND #4 09:12:09 79 #3 Search thermomet* OR (temperature AND measure*) 09:09:41 92377

#4 Search child* OR baby OR infant* 09:09:37 2080702 #1 Search "primary care" OR General practi* Or family practi* OR family physician* Or primary health care* OR primary healthcare* OR family doctor*

Appendix Chapter 3

3.1 Search

Full searching terms list

P	I	O
Parent*	Thermometry/ Thermometers	Knowledge behaviour
Mother*	Temperature*	Skills
Father*	Fever	Comprehension awareness
Families	Thermometer	Understand*
Carer*	Febrile	Attitude* Practice
Caregivers*	Fever	Perception*
Parents	Body temperature	Concern* (anxiety, stress, Frightening, fear, afraid)
		Health knowledge

Parents' knowledge of different methods of measuring temperature, knowledge regarding interpretation of temperature measurements

Cinhal 146 articles found up to 2011 (1982 – January 2011) and 12 news from (1982 – January 2011)

Search Terms Search Options Actions S13 S3 and S8 and S12

Limiters - Exclude MEDLINE records

Search modes - Boolean/Phrase

(146)

S12 S9 or S10 or S11

Search modes - Boolean/Phrase

S11 (MH "Knowledge") OR (MH "Health Knowledge")

Search modes - Boolean/Phrase

S10 (MH "Attitude") OR (MH "Attitude to Health+") OR (MH "Family Attitudes+")

Search modes - Boolean/Phrase

S9 TI (knowledge* OR behaviour* OR behavior* Or Skill* OR comprehension* OR understand* OR attitude* OR perception* OR awareness*) or AB (knowledge* OR behaviour* OR behavior* Or Skill* OR comprehension* OR understand* OR attitude* OR perception* OR awareness*)

Search modes - Boolean/Phrase

S8 S4 or S5 or S6 or S7

Search modes - Boolean/Phrase

S7 (MH "Body Temperature+")

Search modes - Boolean/Phrase

S6 (MH "Thermometers+")

Search modes - Boolean/Phrase

S5 (MH "Fever+")

Search modes - Boolean/Phrase

S4 TI (thermomet* OR Temperature* OR Fever* OR Pyrexi*) or AB (thermomet* OR Temperature* OR Fever* OR Pyrexi*)

Search modes - Boolean/Phrase

S3 S1 or S2

Search modes - Boolean/Phrase

S2 (MH "Parents+")

Search modes - Boolean/Phrase

S1 TI (parent* OR Mother* OR Father* OR Families* OR Family* OR Carer* OR Caregiver*) or AB (parent* OR Mother* OR Father* OR Families* OR Family* OR Carer* OR Caregiver*)

Search modes - Boolean/Phrase

Embase 2691 (up to 2011) 354 new

EMBASE 1974-2011

Searches	Results	Search Type	Actions
1	(parent* or Mother* or Father* or Families* or Family* or Carer* or Caregiver*).tw.	1025337	Advanced
2	exp *parent/	39070	Advanced
3	1 or 2	1035335	Advanced
4	(thermomet* or Temperature* or Fever* or Pyrexi*).tw.	509623	Advanced
5	*fever/	19809	Advanced
6	exp *temperature measurement/	6288	Advanced
7	exp *thermometer/	1427	Advanced
8	body temperature/	37766	Advanced
9	4 or 5 or 6 or 7 or 8	535547	Advanced
10	(knowledge* or behaviour* or behavior* or Skill* or comprehension* or understand* or attitude* or perception* or awareness*).tw.	1827429	Advanced
11	*attitude/ or *attitude to health/ or *attitude to illness/ or *cultural bias/ or exp *family attitude/	54348	Advanced

12	*knowledge/	2967	Advanced
13	*comprehension/	2763	Advanced
14	10 or 11 or 12 or 13	1850205	Advanced
15	3 and 9 and 14	2691	Advanced

Pubmed 3897 articles found up to 2011, up to 2012 284

Pubmed

#13 Search Parent* OR Parenthood* OR Step-Parent* OR Step Parent* OR Stepparent* OR mother* OR father* OR surrogate mother* OR single parent* 11:46:04 430530

#3 Search Search thermomet* OR (temperature AND measure*) 11:40:23 89478

#6 Search baby OR infant* OR infant* OR infancy OR newborn* OR baby* OR babies OR neonate* OR preterm* OR premature* OR postmature* OR child* OR schoolchild* OR school age* OR preschool*or kid OR kids OR toddler* OR Boy* OR girl* OR Minors[MeSH] OR minors* pubescent* OR prepubescent* OR Pediatrics[MeSH] OR paediatric* OR paediatric* OR paediatric* OR Schools[MeSH] OR nursery school* OR kinderman* OR primary school* OR secondary school* OR elementary school* 11:39:34 135018

#8 Search postmature* OR child* OR schoolchild* OR school age* OR preschool*or kid OR kids OR toddler* OR Boy* OR girl* OR Minors[MeSH] OR minors* pubescent* OR prepubescent* OR Pediatrics[MeSH] OR paediatric* OR paediatric* OR paediatric* OR Schools[MeSH] OR nursery school* OR kinderman* OR primary school* OR secondary school* OR elementary school* 11:38:28 135003

#10 Search #3 AND (#8 OR #7 OR #6) AND #9 09:58:02 218

#9 Search "primary care" OR General practi* Or family practi* OR family physician* OR primary health care* OR primary healthcare* OR family doctor* OR practice OR primary practice OR district nurses OR community pharmacist OR physiotherapist OR health visitor* OR community nurse* OR practice nurse* OR community* 09:48:07 886860

#7 Search baby OR infant* OR infant* OR infancy OR newborn* OR baby* OR babies OR neonate* OR preterm* OR premature* 09:44:21 1075981

#5 Search OR baby OR infant* OR Infant∗ OR infancy OR Newborn∗ OR Baby∗ OR Babies OR Neonat∗ OR Preterm∗ OR Prematur∗ OR Postmatur∗ OR Child∗ OR Schoolchild∗ OR School age∗ OR Preschool∗OR Kid or kids OR Toddler∗ OR Boy∗ OR Girl∗ OR Minors[MeSH] OR Minors∗ Pubescen∗ OR Prepubescen∗ OR Pediatrics[MeSH] OR Paediatric∗ OR Paediatric∗ OR Peadiatric∗ OR Schools[MeSH] OR Nursery school∗ OR Kindergar∗ OR Primary school∗ OR Secondary school∗ OR Elementary school∗ 09:41:51 134511

#4 Search child* OR baby OR infant* "primary care" OR General practi* Or family practi* OR family physician* Or primary health care* OR primary healthcare* OR family doctor* 09:37:59 163007

#2 Search "primary care" OR General practi* Or family practi* OR family physician* Or primary health care* OR primary healthcare* OR family doctor* OR "out-of-hours" OR "office visits" 09:35:09 191009

#1 Search child* OR baby OR infant* OR toddler* OR school* OR newborn* OR infant* 09:34:14 3725315

PsycINFO 1967-2011 363 articles

2011 -2012 -> 31 new articles up to 2012

1 (parent* or Mother* or Father* or Families* or Family* or Carer* or Caregiver*).tw. 390865 Advanced

2 exp Parents/ 61091 Advanced

3 1 or 2 392455 Advanced

4 (thermomet* or Temperature* or Fever* or Pyrexi*).tw. 12159 Advanced

5 hyperthermia/ 682 Advanced

6 exp body temperature/ 3440 Advanced

7 4 or 5 or 6 12734 Advanced

8 3 and 7 834 Advanced

9 (knowledge* or behaviour* or behavior* or Skill* or comprehension* or understand* or attitude* or perception* or awareness*).tw. 1165675 Advanced

10 exp Health Knowledge/ 4420 Advanced

11 exp Parental Attitudes/ or Attitudes/ or exp Health Attitudes/ 38960 Advanced

12 exp Comprehension/ 22822 Advanced

13 9 or 10 or 11 or 12 1177020 Advanced

14 8 and 13 363 Advanced

15 limit 14 to yr="2011" 31 Advanced

3.2 Explanation for title and abstract screening

Background and aims (a very brief overview)

Parents are in most cases the first step towards fever detection in their children. Surveys have suggested that about a quarter of parents will treat their children with antipyretics when their temperature is within a normal range. Most parents do not know when to read thermometers and how long to leave them in still before reading the measurements. It will be interesting to understand the knowledge, interpretation and skills that parents have of temperature measurements.

Selection

Studies selected will have to show parents (father, mother or caretaker) interpretations and/or knowledge and /or skills of thermometry must and include one of the following variables:

1) The understanding of different of temperature measurements and/or their importance (father, mother or caretaker).
2) Accuracy/skills while taking temperature measurements (father, mother or caretaker).
3) Understanding/knowledge/interpretation of temperature measurements (father, mother or caretaker).

<u>Articles that may not be included</u>

- Studies are related to a specific disease, yellow fever, malaria, dengue fever, Mediterranean fever will not be included.

- Urinary tract infections or skin infections will not be included

- Short reports studies will not be included.

- Education programs.

  Studies will in many cases include fever and or fever interpretations. However, thermometry and fever are terms used in some studies indistinctively and they are not (thermometry looks at measurement of temperature whereas fever is a symptom of abnormally high body temperature) e.g.:

- A study about fever where there is no reference to measurement/interpretation/skill/knowledge of temperature measurement will not be considered.

A study selected about fever where different temperature thresholds/interpretations/skills are considered will be included.

3.3 Study quality

Quality assessment of studies

Author	Country *	Selection bias	Study size	Completion rate	Study piloted
Abdullah et al., (1987)	Saudi Arabia (1)	Moderate	High	Low	No
Al-Abdel Jalil, et al., (2007)	Kuwait (1)	Moderate	Low	Low	No
Al-Eissa et al., (2000)	Saudi Arabia (1)	Moderate	Low	Low	No
Al-Eissa (2000)	Saudi Arabia (1)	Moderate	Low	Low	No
Al-Mohsen (2005)	Kingdom of Bahrain (1)	Moderate	Low	Low	No
Al-Nouri (2006)	Iraq (3)	Moderate	Moderate	Low	No
Andersen (1988)	USA (1)	Moderate	Moderate	Low	No
Arica (2011)	Turkey	Moderate	Low	Low	No
Betz (2006)	United Arab Emirates (1)	Moderate	Moderate	Low	No
Blumenthal (1998)	UK (1)	Moderate	Low	Low	No
Boivin (2007)	France (1)	Moderate	Low	Low	No
Collazo (1992)	Puerto Rico (1)	Moderate	Moderate	Low	No
Crocetti et al., (2001)	USA (1)	Moderate	Low	Low	No
Crocetti et al., (2009)	USA (1)	Moderate	Moderate	Low	No
Cuzzolin et al., (2004)	Italy (1)	Moderate	Low	Low	No
Erkek et al., (2010)	Turkey (2)	Moderate	Moderate	Low	No

Esenay et al., (2007)	Turkey (2)	Moderate	Low	Low	No
Fletcher (1986)	USA (1)	Moderate	Moderate	Low	No
Impicciatore et al., (1998)	Italy (1)	Moderate	Low	Low	Yes
Karwowska et al., (2002)	Canada (1)	Moderate	Low	Low	No
Kilmon (1987)	USA (1)	Moderate	Moderate	Low	No
Kim et al., (2009)	Korea (1)	Moderate	Low	Low	No
Kramer et al., (1985)	Canada (1)	Moderate	Moderate	Low	No
Kurugol et al., (1995)	Turkey (2)	Moderate	Moderate	Low	No
Linder et al., (1999)	Israel (1)	Moderate	Low	Low	No
Matziou et al., (2008)	Greece (1)	Moderate	Low	Low	No
Moraga et al., (2007)	Chile (2)	Moderate	Moderate	Moderate	No
Pan (2003)	Singapore (1)	Moderate	Moderate	Low	No
Poirier et al., (2010)	USA (1)	Moderate	Moderate	Low	No
Porter (2000)	USA (1)	Moderate	High	Low	No
Purssell (2009)	England	Moderate	Moderate	Low	No
Rendon-Macias et al., (1996)	Mexico (2)	Moderate	Low	Low	No
Rupe et al., (2010)	USA (1)	Moderate	Low	Low	No

Sakai (2011)	Japan (1)	Moderate	Moderate	Low	No
Sarrell et al., (2002)	Israel (1)	Moderate	Low	Low	No
Saz. et al., (2009)	Turkey (2)	Moderate	Moderate	Low	No
Schmitt (1980)	USA (1)	Moderate	High	Low	No
Schwartz et al., (1997)	USA (1)	Moderate	Low	Low	No
Singhi (1990)	India (3)	IR	Moderate	Low	No
Singhi (1990) 2	India (3)	IR	High	Low	No
Stagnara et al., (2005)	France (1)	Moderate	Moderate	Low	No
Sunter et al., (1997)	Turkey (2)	Moderate	Moderate	IR	No
Taveras et al., (2004)	USA (1)	Low	Moderate	Low	No
Walsh et al., (2008)	Australia (1)	Moderate	High	Low	No
Ybarra Huesa et al., (2003)	Spain (1)	Moderate	Low	Low	No

* World Bank classification

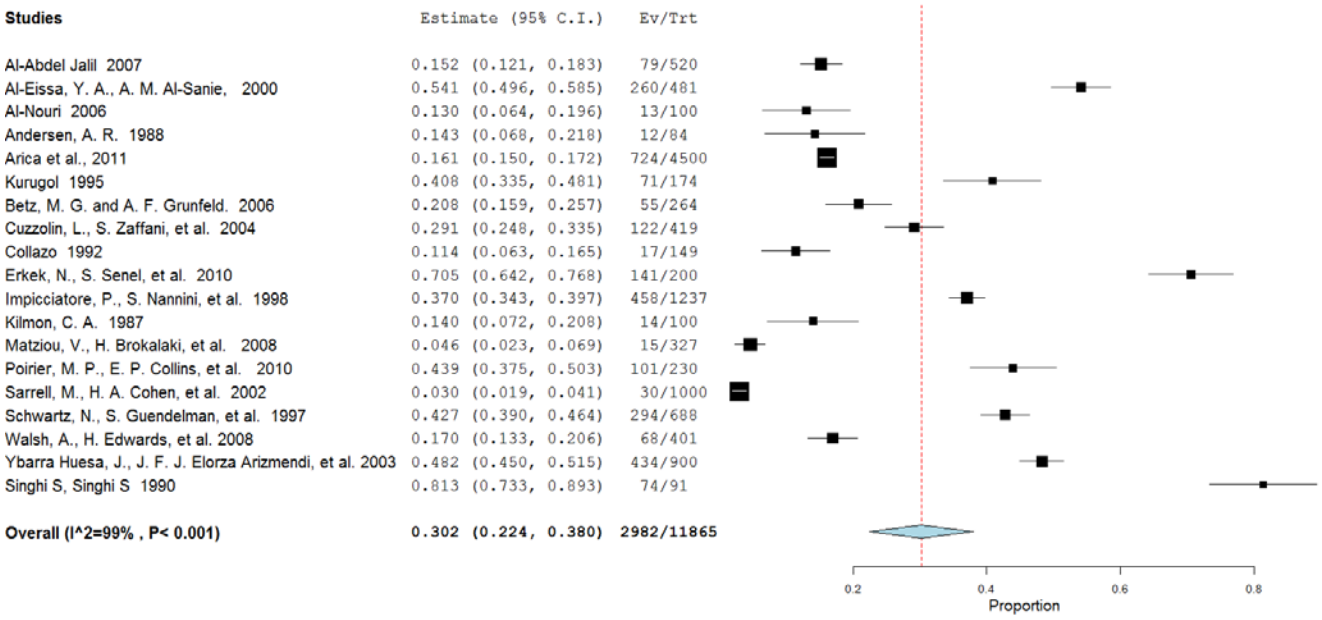
3.4 Examples of heterogeneity using fixed effects and random modelling meta-analytical techniques

Binary Random-Effects Model of proportion of parents with low level of education

Table 1. Random effects meta-analysis: proportion of parents with low level of education

Model Results	**Estimate**	Lower bound	Upper bound	Std. error	p-Value
	0.302	0.224	0.380	0.040	<0.001
Heterogeneity	*tau^2*	*Q (df=20) Het.*	*p-Value*	*I^2*	
	0.029	*2470.142*	*< 0.001*	*99.272*	

Figure 1. Forest plot of random effects meta-analysis of proportion of parents with low education level



The results indicate very great statistical heterogeneity ($p < 0.001$), most of which cannot be attributed to chance (I squared statistic > 99%). The Forest plot demonstrates the considerable dispersion of the individual study point estimates. The pooled summary estimate exhibits quite wide 95% confidence intervals (0.224 to 0.380).

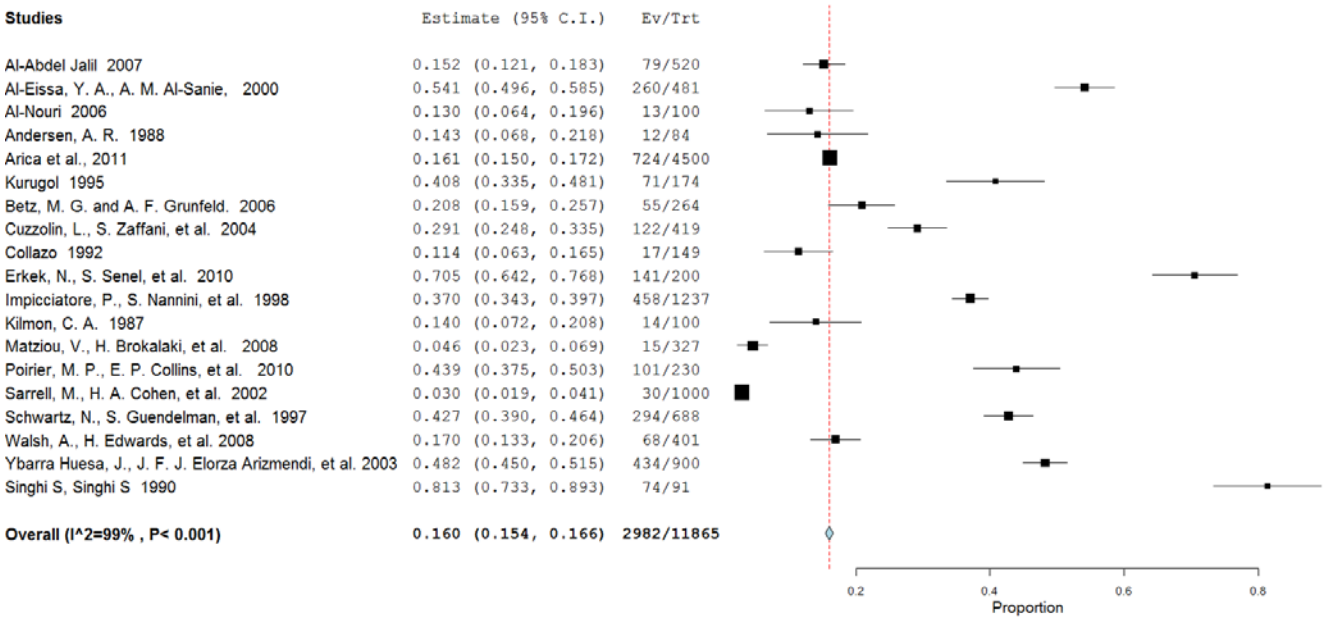
Binary Fixed-Effects Model of proportion of parents using sponging.

Table 2 summarise the results using fixed effects meta-analysis, and the corresponding Forest plot is shown in Figure 2

Table 2. Fixed effects meta-analysis of proportion of parents with low level education

Model Results	**Estimate**	Lower bound	Upper bound	Std. error	p-Value
	0.160	0.154	0.166	0.003	< 0.001
Heterogeneity	*Q (df=20) Het.*	*p-Value*			
	2470.142	*< 0.001*			

Figure 2. Forest plot of fixed effects meta-analysis of proportion of parents with low level education



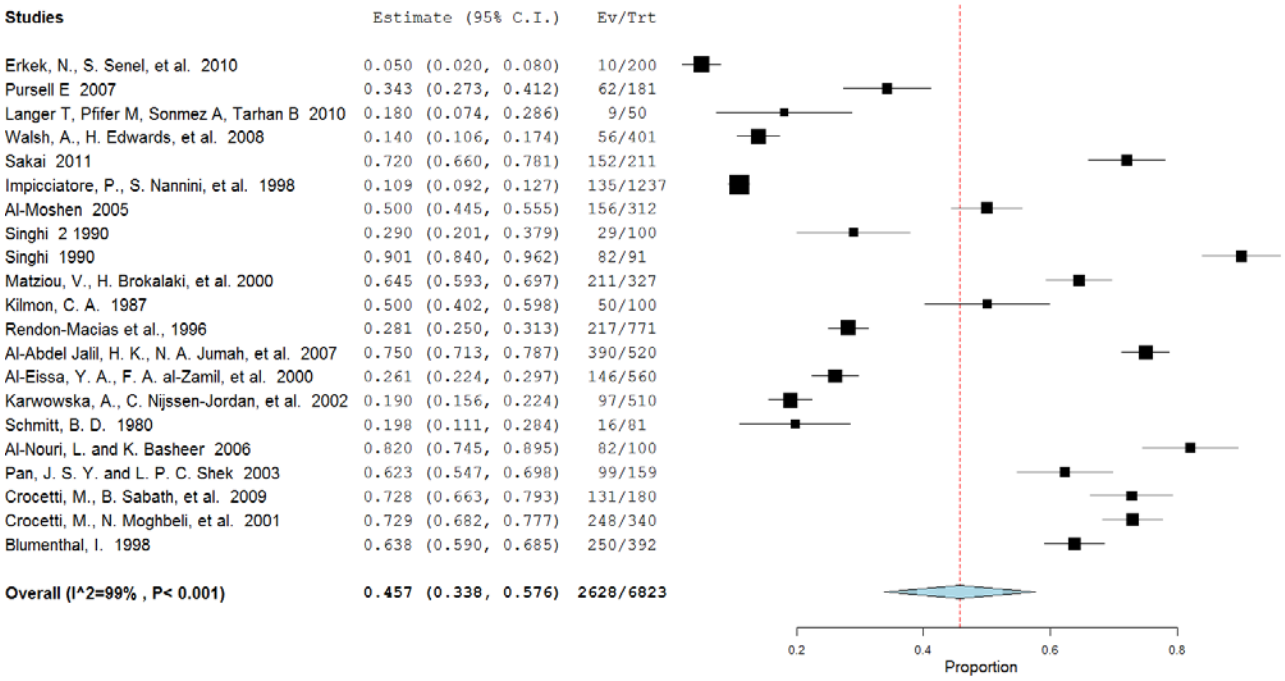
The considerable statistical heterogeneity demonstrated in the Cochrane's Q statistic means that this model has limited validity for this data set.

Binary Random-Effects Model of proportion of parents using sponging.

Table 1. Random effects meta-analysis of proportion of parents using sponging

Model Results	**Estimate**	Lower bound	Upper bound	Std. error	p-Value
	0.457	0.338	0.576	0.061	< 0.001
Heterogeneity	*tau^2*	*Q (df=20) Het.*	*p-Value*	*I^2*	
	0.077	*3140.082*	*< 0.001*	*99.363*	

Figure 1. Forest plot of random effects meta-analysis of proportion of parents using sponging



The results indicate very great statistical heterogeneity ($p < 0.001$), most of which cannot be attributed to chance (I squared statistic > 99%). The Forest plot demonstrates the considerable dispersion of the individual study point estimates. The pooled summary estimate exhibits wide 95% confidence intervals (0.338 to 0.576).

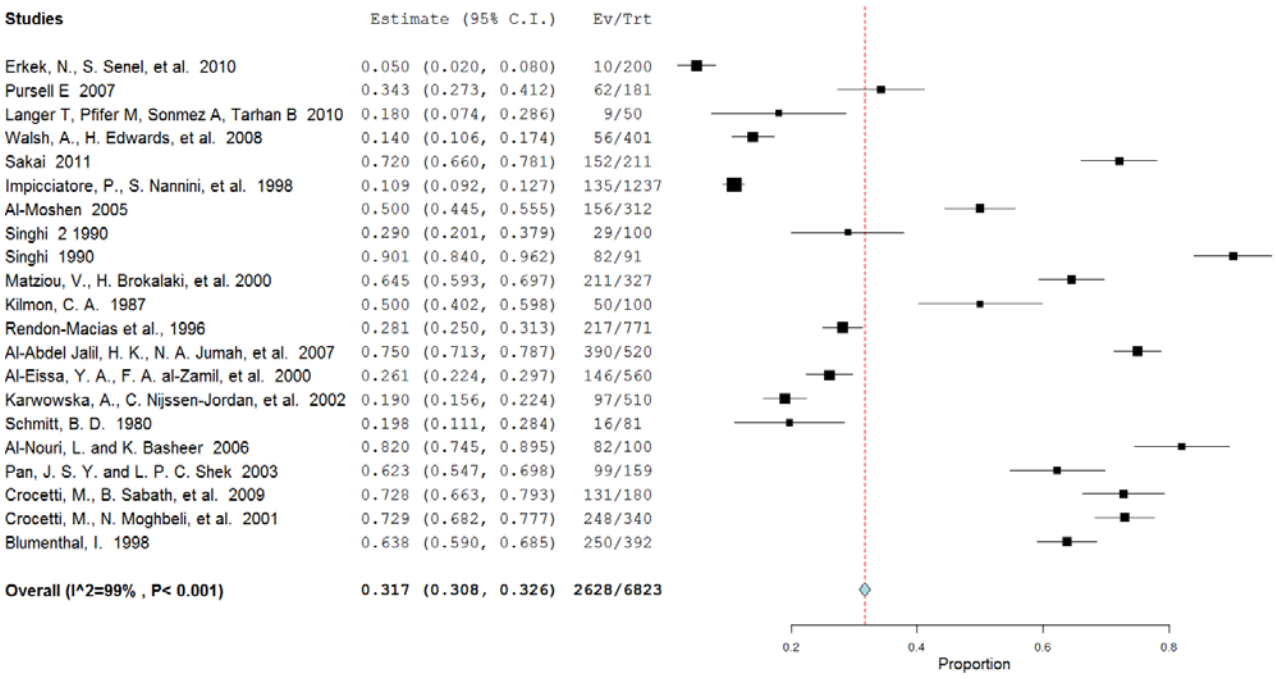
Binary Fixed-Effects Model of proportion of parents using sponging.

Table 2 summarise the results using fixed effects meta-analysis, and the corresponding Forest plot is shown in Figure 2

Table 2. Fixed effects meta-analysis of proportion of parents using sponging

Model Results	**Estimate**	Lower bound	Upper bound	Std. error	p-Value
	0.317	0.308	0.326	0.005	< 0.001
Heterogeneity	*Q (df=20) Het.*	*p-Value*			
	3140.082	*< 0.001*			

Figure 2. Forest plot of fixed effects meta-analysis of proportion of parents using sponging



The considerable statistical heterogeneity demonstrated in the Cochrane's Q statistic means that this model has limited validity for this data set.

Appendix Chapter 4

4.1 Protocol

UNIVERSITY OF OXFORD

C F Well

Child Fever and Wellness Study

Developing a theoretical framework for an intervention to improve parental and carer performance on temperature measurement, fever care and knowledge of feverish illness in children: a survey and two focus group interviews

C F Well (CHIF Well study) protocol version 2.0 (11-APR- 2013)

Last saved by Jose Hernandez

Funding: NIHR

Investigators

Chief investigator – Mr Jose Hernandez

Co-investigator – Dr Carl Heneghan

Co-investigator – Dr Matthew Thompson

Sponsor

University of Oxford

1. Introduction

1.1 Background

One of the main reasons for parents to use primary care, secondary care or emergency services is when they believe their children with feverish illness need urgent attention[9]. Fever has been reported as the main reason for 40% of parents of children aged less than 6 months, as well as 60% of children aged 6 months to 5 years to attend GP practices, and the second most common reason for children to attend emergency care[9].

Infection is the underlying cause for fever in most cases and infection is a leading cause of death. Infection is a major cause of mortality in children between 0 to 5 years of age with up to 1% of children in the UK having serious infections (meningitis, septicaemia, urinary tract infections and pneumonia) and the severity of meningococcal disease or serious bacterial illnesses cannot be underestimated[1 2 11 12]. A large intervention trial of 439 children birth registers at 3 collaborating centres in the United Kingdom[13] (Leicester, Nottingham, and Norwich) estimated that an average of eight infective episodes occurred in healthy children within the first 18 months of their life. According to a public health report from Heart of Birmingham Teaching Primary Care Trust (HoB tPCT)[14] 11.2% of all infant deaths in the West Midlands between 2003 to 2007 were due to infectious diseases.

As a result of this, in May 2007 NICE published a clinical guideline offering best-practice advice in the assessment and initial management of feverish illness in children younger than 5 years of age[9]. The guideline contained advice for parents and caretakers for their children's care. Alongside the guideline NICE published a supplement named "Information for the public" (parents and caretakers) in which it provided advice for children's fever care at home. Some of the advice contained in this document was the recognition of symptoms of more serious illness, advice on home care and for referral to further care where necessary. In November 2012, an update to the guideline was published[243]. The Guideline Development Group recommended (adding to the previous guideline) studies on home-based antipyretic use and parental perception of distress caused by fever. The study was suggested to include

parents' and carers' interpretation of this, including: help-seeking behaviour, what triggers presentation to a healthcare professional, what triggers the decision to give a dose of antipyretic, and what triggers the decision to change from one antipyretic to another.

Further studies with a greater insight into parental and carer's care of feverish illness in children are necessary. It is important to understand how much care and what type of management parents are giving to their children when they have a fever. It also important to understand why and which circumstances lead parents and carer's of children to seek for further care in the case of fever.

1.2. Rationale for the current study

An unpublished systematic review[160] has shown that parental interpretation and knowledge of fever may not always be accurate. In this regard, the review highlighted that parental knowledge of temperature thresholds considered to be a fever are not always correct and antipyretic medication sometimes may be administered at low temperature thresholds. Furthermore, it suggested that parents had concerns about fever even at mild temperatures. Consequences from fever such as brain damage, febrile convulsions and death were mentioned irrespective of parental education or socio-economic status. Increased use of antipyretics to reduce fever, waking sleeping febrile children and sponging were common practices among parents.

Studies have recognised a lack of parental knowledge on temperature measurement and fever. Over 3 decades[92 94 97 98] research has suggested parent's erroneous interpretation of temperature measurements and care of fever in children. These studies are widely represented geographically, however there have been just two studies[95 108] in the United Kingdom (UK). Furthermore, it is not known whether parents and carers are following NICE guideline recommendations when measuring the temperature of their children or managing feverish illness.

Since the UK studies[95 108] on temperature measurement have been published there has been no further audit on parental knowledge, care and interpretation of fever in UK. Furthermore,

there is no knowledge that providing parents and carers with advice from the guideline has any impact on their knowledge and management of feverish illness. It is therefore important to understand the current situation by undertaking an additional study. This study will use information from questionnaires from previous studies.

2. Study objectives

2.1. Aim

This main aim of this study is to learn more about how much parents and carers of children know about temperature measurements, fever and its care in the children they are taking care of. Also focus group interviews will help us comprehend their beliefs of fever management and temperature taking. The study describes the methods and results from one survey questionnaire and two focus group interviews.

The overall aim of the questionnaire is to understand what parents and carers of children know about temperature measurement and fever management in children younger than 5 years. This will help assess current parental and carer knowledge of temperature and fever management, while understanding where parents and carers get their information from. The hypothesis that parents and carers do not follow the NICE leaflet recommendations to interpret temperature in a child and do not always have sufficient knowledge to provide adequate care in the case of feverish illness will be investigated through this self-administered questionnaire.

A focus group interview will be used to describe and assess parents and carers understanding of fever. It will try to understand parental and carer's knowledge, beliefs and practices on the management of fever and temperature taking in children under five years. This research could lead to a better understanding of how to inform parents and carers in their care of children with fever through primary care.

2.2. Objectives

1) *Objectives from the questionnaire*

- Understand parental and carer use of thermometers and what type/s they use.
- Assess how parents and carers learn to read a thermometer.
- Assess parental and carer understanding of temperature measurements that require further care in babies in comparison to the NICE leaflet advice.
- Assess parental and carer care of feverish illness in comparison to the NICE leaflet advice.
- Understand whether having more than one child can have an impact on knowledge about temperature measurement and fever care.

2) *Objectives from the focus group interviews*

- Understand parents and carers' beliefs and knowledge of temperature taking.
- Assess how parents and carers identify a febrile child.
- Understand parents' and carers' beliefs about fever.
- Comprehend parents' and carers' fever knowledge.
- Understand how parents and carers learn to manage fever

Inclusion criteria

Parents and carers taking care of children of 5 years of age or less

- ≥ 18 years of age
- Good understanding and comprehension of English
- Willing and able to give informed consent form

Exclusion criteria

A participant may not enter the study if the following applies:

- The participant does not live with the child and does not spend time caring for the child. This care should be of a reasonable length of time to be included (i.e. full weekends, after school each week day). A minimal amount of 8 hours of care a week will be required to be eligible as a carer in this study.

3. Study Design

3.1. Plan of investigation

The study will compromise of a survey of parents and carers of children 5 years or less in age through a closed question, questionnaire. Two focus group interviews will run alongside the questionnaire survey. The information obtained from the questionnaire and the focus group interviews will help defining components of a more complex intervention[244] to help improving parental understanding of fever more widely. The overall aim of this study is to understand parental and carer knowledge of fever and its management.

3.2. Parent and carer survey and focus group interview

A self-administered questionnaire with closed questions about temperature measurement and fever care in children will be administered to parents and carers of children under five years

of age. Parents and carers asked to participate in the focus group interviews will belong to the same practices where the questionnaires will be carried out, but will be different parents and carers from those filling up the questionnaire. The specific time and venue for the focus group interviews will be arranged to suit the parents and the carers. After 250 parents and carers have been recruited from the questionnaire survey parents and carers will be recruited randomly either for the questionnaire or for the focus group interviews.

3.3. Study outcomes

Primary outcomes

1) *From the questionnaire*

- Participants' knowledge of temperature measurement can be determined from participants' scores from the questionnaire on thermometer use. It will include whether participants have a thermometer and what type of thermometer it is, and, where they have learnt to read a thermometer from. Participant's knowledge about fever management in children younger than 5 years in relation to the NICE leaflet can be determined by participant scores when answering questions from the questionnaire such as the temperature required to taking a baby to further care, or the type of fever management required (antipyretics, regular drinks) to lower a child's fever.

2) From the focus group interview

- Participants thoughts and beliefs of temperature taking will be drawn from the themes obtained from transcripts that will emerge from the focus group interview when they are asked whether they have a thermometer and if they feel comfortable using it. Beliefs of temperature management will be drawn from themes from participant's thoughts of child care, from their thoughts of managing a fever and how they have learnt to manage it.

Secondary outcomes

1) *From the questionnaire*

- To determine parental and carer knowledge of temperature thresholds that requires further care in babies, by analysing scores from participants answers related to the temperature that will make them take babies around three months old further into care.

- To examine parental and carer use of different types of thermometers in children in the UK by analysing scores from participant's answers of thermometer ownership and usage.

- To assess parental and carer knowledge of care of feverish illness in children according to the NICE leaflet. This will be examined by analysing scores from participants' answers on action to manage fever (taking a baby into further care and using pharmacological or other therapy to lower temperature down).

- To assess whether having more than one child can have an impact on parental and carer knowledge of care of feverish illness in a child. This will be examined comparing participant's answer means on management of care with the number of children participants care for.

2) From the focus group interview

- Understand parents' and carers' beliefs and knowledge of temperature taking. Participants thoughts and beliefs of temperature taking will be drawn from the themes that will emerge from the focus group interview transcripts when they are asked whether they have a thermometer and if they feel comfortable using it.

- Assess how parents and carers identify a febrile child. Participant's thoughts and beliefs of identifying a febrile child will be drawn from emerging themes from the

focus group interviews when they are asked how they know when the child they care for has a fever.

- Understand parents' and carers' beliefs about fever. Participants thoughts and beliefs about fever will be drawn from emerging themes from the focus group interviews when they are asked about their thoughts and worries when the children they care for have a fever.

- Comprehend parent's and carers' fever knowledge. Participants thoughts and beliefs of fever knowledge will be drawn from the emerging themes from the focus group interviews transcripts when they are asked about what they know about fever of whether they think it may be beneficial or not.

- Understand how parents and carers learn to manage fever. Participants thoughts and beliefs of management of fever will be drawn from emerging themes from transcripts when they are asked how they have learn to look after a child with a fever or information they think they require to do so.

4. Questionnaire survey and focus group interviews explanation

4.1. Recruitment of parents and carers for the questionnaire

Parents and carers will be sampled from a single geographic setting in order to maximise the response rate, this will mean that this results will be highly representative of the parents and carers in the area, and areas with a similar population demographics within the UK. Carers are defined for the purpose of this study as anyone over the age of 18 years of age (e.g. nanny, friend of the family) who provides support for the care of a child under five years of age. A minimal amount of 8 hours of care weekly every week will be required to be eligible as a carer in the study.

Practices will be selected from the Primary Care Research Network, these are practices that already collaborate in projects with the Department of Primary Health Care Sciences at Oxford. One of the practices taking part in the study will be the Jericho Health Centre and Dr Carl Heneghan will be one of the participating GPs. The next participating practice will be selected after the ethical approval has been granted. The study will take place when the Chief Investigator is at the practice. He will be in one practice at the time, he will be in different practices at different times; if more than one practice is selected at least one practice from a more deprived area of Oxford will be chosen to increase the representativeness of the sample. A random sample of the parents and carers will be obtained from those parents and carers that are registered in the practices. GPs will identify eligible participants when they attend the surgery during their consultation, from parents and carer's medical and paper records and GPs will ask participants whether they care for a child (a minimal amount of 8 hours of care weekly every week). They will provide the Patient Information Sheet (PIS), an invitation letter and tell the participants that the Chief Investigator is in the waiting room and if participants are interested he will be able to answer any questions they may have (this process may take up to 30 seconds from the GP's consultation time). If they wish to take part, then the questionnaire can be obtained from the Chief Investigator and be completed, completion of the questionnaire is considered to be consent from the participants. This may take place in the waiting room, if participants feel they require more time to go through the forms, envelopes with paid postage and addressed to the Department of Primary Health Care Science will be provided for participants to send their questionnaires. Thus, parents and carers can fill in the all the forms and send them in their own time back to the Chief Investigator. A poster will be up in the waiting room explaining the study and advising parents and carers to ask the receptionist or the doctor if they want to take part. If they do they will be given the Chief Investigator details to contact.

4.2. Recruitment of parents and carers for the focus group interviews

Parents and carers in the focus group interview will be recruited from the same practices where parents and carers will be recruited to complete the questionnaire. GPs will identify eligible participants when they attend the surgery during their consultation, from the patient records. They will provide the PIS and an invitation letter and tell the participants that the Chief Investigator is in the waiting room, and if participants are interested he will be able to answer any questions they may have (this process may take up to 30 seconds from the GP's

consultation time). If they wish to take part then consent can be taken at the practice or on the day of the focus group interview before starting it. Recruitment to the focus groups will begin when 250 parents and carers have been recruited to complete the questionnaire. Parents and carers will be asked to provide their contact details, they will be then be contacted to choose a specific time and venue that suits them for the focus group interviews. Parents' and carers' contact details will be erased once the study has been completed.

4.3. Remuneration for participants

In the event they need to travel to meet the Chief Investigator for the focus group interview participants will be reimbursed any traveling expenses within Oxfordshire. Parents and carers who participate in the focus group interviews will also be given a free thermometer with a market value over £15. Parents and carers who complete the questionnaire will not have to return to the surgery so they will not be given any remuneration.

5. Sample size

For the questionnaire a suggested minimum number of 271 questionnaires will be necessary in order to cover caregivers and carers from different socioeconomic backgrounds and different ethnic groups. Assuming that 50% of caregivers will not have a good understanding of taking temperature measurements and about the care of feverish illness in children younger than 5 years of age, with a confidence level of 90% and a ±5% of error will be required a minimum of 271 caregivers. In order to obtain questionnaires completed from 271 parents and carers, it is estimated that a number of up to 1000 parents and carers will need to read the Participant Information Sheet assuming a response lower that 30% from the questionnaire. Where possible a number greater than 300 questionnaires will try to be obtained.

The focus groups interviews will be formed of 2 groups from 6 to 10 parents and carers, this number has been suggested by previous research[170] as an adequate number of participants to run the group interviews and draw some meaningful conclusions.

6. Study management

The day-to-day management of the study will be co-ordinated by the Chief Investigator.

7. Adverse events

This is a descriptive study and has no risks of adverse events. However, the University of Oxford, as Sponsor, has appropriate insurance in place in the unlikely event that a participant suffers any harm as a direct consequence from participation in this study.

If participants wish to complain about any aspects of the way in which have been approached or treated during the course of this study, they should contact the Chief Investigator Mr Jose Hernandez on 01865289325 or email him to jose.hernandez@phc.ox.ac.uk. Alternatively they can contact the University of Oxford Clinical Trial and Research Governance (CTRG) office on 01865572224 or the head of CTRG, email ctrg@admin.ox.ac.uk

8. Data analysis

8.1. Data analysis

1) From the survey questionnaire

The result from the first questionnaire will be analysed using descriptive statistics including proportion with exact 95% of confidence intervals and appropriate summary necessary will be used in order to summarize every answer. Key variables (such as knowledge of specific temperature thresholds that require further care) will be assessed using T-tests to compare the sampled population and determine if there is a significant difference between their means. Statistical analysis will be done using PASW Statistics 18 Data Document.

2) From the focus group interviews

Descriptive data will be summarised from the focus group interviews. Open-ended responses will be analysed using qualitative thematic methods. Expected and appearing themes will be included to ensure that all perspectives are incorporated in the explanation of the data.

There will be flexibility on each one of the themes that participants will comment on, however the facilitator will make sure that the parental and carer comments do not divert from the themes. Focus group interviews will be taped, transcribed and analysed by the lead researcher. Expert knowledge and help will be sought from qualitative researchers at the

beginning of this process. Data collection and analysis will be iterative as data collection in the focus group interviews proceeds, with new data being used to challenge and assess or confirm emerging analysis. Key categories and concepts emerging from each one of the two focus groups will be considered as aggregated one to the other.

The results from the focus group interview in conjunction with the pathways analysis will inform the design of and help modelling a more complex intervention to improve parental and carer performance on temperature measurement, fever care and knowledge of feverish illness in children.

8.2. Data handling, record keeping and retention

All data obtained from questionnaires will be held securely and treated in the strictest confidentiality. Personal data for organising the focus groups will be stored held at the university and then anonymised once used; an access database will have the details from patients but will not contain personal details, that database would be only accessible for the Chief Investigator. All data extracted will be stored in locked filling cabinets. Electronic data will be stored on the computers serves within the University of Oxford requiring passwords to log on to the network only know to the Chief Investigator.

8.3 Publication policy statement

The Chief Investigator will be involved in reviewing drafts of the manuscripts, abstracts, press releases and any other publications arising from the study. Authors will acknowledge that the study was funded by The University of Oxford. Authorship will be determined in accordance with the ICMJE guidelines and other contributors will be acknowledged.

9. Regulatory issues

9.1. Ethics approval

Declaration of Helsinki

The Chief Investigator will ensure that this study is conducted in accordance with the principles of the Declaration of Helsinki.

ICH Guidelines for Good Clinical Practice

The Chief Investigator will ensure that this study is conducted in full conformity with relevant regulations and with the ICH Guidelines for Good Clinical Practice (CPMP/ICH/135/95) July 1996, including training in GCP for clinicians as required.

Approvals

The protocol, informed consent form, participant information sheet and any proposed advertising material will be submitted to an appropriate Research Ethics Committee (REC) and host institution(s) for written approval. The Chief Investigator will submit and, where necessary, obtain approval from the above parties for all substantial amendments to the original approved documents.

9.2. Informed consent

All potential participants will be provided with a Participant Information Sheet and the appropriate consent form for them to sign if they agree to participate in the study. The Participant Information Sheet will include contact telephone numbers, address and email of the research team who will be able to answer any questions that the parents and carers may have before signing the consent form. The Chief Investigator will ensure that the participants understand what is involved in the study before they consent to take part. If parents and carers are willing to participate they will have to sign two copies of the consent form, one copy of which they will retain.

9.3. Confidentiality

All data from questionnaires will be held securely and treated in strict confidentiality; data held at the university will be anonymised, all personal identifiers will be removed from the data whilst maintaining a connection between the data and personal identifiers through an id number. An excel database will have the details from patients, that database will only be accessible by Chief Investigator. All data and transcripts will be stored in locked filling

cabinets. Electronic data will be stored on the computers serves within the University of Oxford requiring passwords to log on to the network only know to the Chief Investigator.

Contact details will be collected from participants in order to send to arrange the focus groups; once the focus group interviews have been completed they will be erased. These records will be kept securely at the Department of Primary Care Health Sciences in locked shelves on a restricted access floor.

The Chief Investigator will preserve the confidentiality of data obtained in the study; this data will be protected under the Data Protection Act. Confidentiality will be monitored by the University of Oxford. If data is transferred outside the EU, consent must also be sought for this.

9.4. Indemnity

As sponsor the University of Oxford insurance policies will apply to this study. The University of Oxford has in place a Public Liability policy and/or Clinical Trials Policy which provides cover for claims for “negligent harm” and the activities here are included within that coverage.

9.5. Sponsor

The University of Oxford will act as the main sponsor for this study.

9.6. Funding

NIHR are funding this study.

9.7. Audits

The study may be subject to inspection and audit by the University of Oxford under their remit as sponsor, and other regulatory bodies, to ensure adherence to GCP and the NHS Research Governance Framework for Health and Social Care.

10. References

12. Appendix A: Study personnel contact details

Brief study title: CHIF Well **Study start date:** June-July 2013

Personnel	Name	Address	Telephone	E-mail
Sponsor	Ms Heather House	Clinical Trials and Research Governance Joint Research Office, Block 60, Churchill Hospital, Headington, Oxford	+44 (0)1865572228	ctrg@admin.ox.ac.uk
Chief Investigator	Jose Hernandez	University of Oxford Department of Primary Care Health Care Sciences, New Radcliffe House, Radcliffe Observatory Quarter, Oxford, OX2 6GG	+44 (0)1865 5289323	jose.hernandez@phc.ox.ac.uk
Co-investigator	Dr Carl Heneghan	University of Oxford Department of Primary Care Health Care Sciences, New Radcliffe House, Radcliffe Observatory Quarter, Oxford, OX2 6GG	+44 (0)1865 289299	carl.heneghan@phc.ox.ac.uk
Co-investigator	Dr Matthew Thompson	University of Oxford Department of Primary Care Health Care Sciences, New Radcliffe House, Radcliffe Observatory Quarter, Oxford, OX2 6GG	+44 (0)1865 289300	matthew.thompson@phc.ox.ac.uk

4.2 PIS, invitation letter, contact details form and consent form

PIS

C  F Well

Child Fever and Wellness  **Study**

Focus Group Interview Participant Information Sheet

Parental understanding of temperature measurements and fever care

You are being invited to take part in a research study.

This information sheet explains why the research is being conducted and what will happen should you decide to participate.

Please read it carefully and talk to others about the study if you require. Please ask if there are any parts which you do not understand or if you would like more information.

Please take your time to decide on whether you wish to participate in the study.

1. What is the purpose of this study?

This study is being done to learn more about how much parents and carers know about temperature measurements, fever and the decisions they make when caring for children. This study will shed new light in the understanding of parental management and knowledge of fevers in children aged up to 5 years of age as there has been very limited and outdated research in the area.

2. Why have I been invited?

You have been invited because you are a parent of a child aged up to 5 years old. The child you are caring for may not have a high temperature at the moment but we want to find out about parental knowledge of high temperatures. We aim to recruit one or two groups of 6 to 10 parents. This research is being undertaken as part of an educational project as fulfilment for an academic qualification.

3. Do I have to take part?

It is you choice to take part in the study. We will ask you to sign a consent form the day the study is carried out however should you decide not to take part, or should you initially agree to participate but then decide not to take part in the study at a future date, you may withdraw without giving any reason, this will not affect your future care.

4. What will happen to me if I take part?

In this study we are asking parents to participate in one of two group interviews which will try to understand parental knowledge, beliefs and practices on the management of fever and temperature taking in children aged 5 years or under.

The focus group session will last for about an hour and will be held at the GP Practice or, if more convenient, at the University of Oxford, in the Department of Primary Care Health Sciences. It will consist of a group of 6 to 10 parents where a Research Student will lead discussions on various topics to do with temperature monitoring and advice on fever. The Research Student will take notes throughout the discussion and the whole session will be recorded using audio equipment. Only authorised personnel will listen to this recording.

If, once you have read through the information, you wish to participate in the study you can fill in your details in the contact details form attached to this pack. You can introduce your filled contact details form in one of the empty sealed boxes in the waiting room of you practice that are located next to the poster of this study. These sealed boxes have a mail slot where you can introduce safely your contact details form. You may take as long as you need to decide whether you want to participate in the study. After this you will be contacted about organising a date and time for the focus group session if you are selected for the study. Consent for the study can be signed on the day of the focus group.

5. What are the disadvantages or benefits of taking part?

Taking part will help improve the information that parents and carers are given about temperature measurements and fever. It may also help participants understand in more detail what a fever is and the simple measures of how to take care of a child should it occur. We do not anticipate that there are any disadvantages in taking part, only the additional time it takes to complete the focus group interviews.

6. Will my taking part in this study be kept confidential?

Yes. Names will be coded with a personal identifier and so all data will be anonymous. We will keep the digital recordings of each discussion group in a secure location for 10 years after the study has been completed. All the information we record digitally, in notes or using any other method(s) will be kept securely according to the Data Protection Act 1998, to protect your personal information. All personal contact details collected for the study will be erased once your participation in the study is completed. The data collected for the study may be looked at by individuals from the University of Oxford and from the local NHS trust to ensure that we are complying with regulations.

7. Will I be reimbursed any expenses or remunerated?

In the event that you need to travel for the focus group interview, you will be reimbursed any traveling expenses within Oxfordshire. You will also be given a free thermometer with a market value of over £15.

8. What will happen if I don't want to carry on with the study?

If you decide that you no longer wish to participate in the study, you can email, phone or write to the Research Student (see section below for contact details), any information you have contributed will be kept as part of the study unless you request that it is deleted. You

can leave this study at any point and you do not have to tell us why. Leaving the study will not affect you or your child's continued care in anyway.

9. What if there are any problems?

Given the nature of this study, it is highly unlikely that you will suffer harm by taking part. However, as Sponsor, the University of Oxford has appropriate insurance in place in the unlikely event that you suffer any harm as a direct consequence of your participation in this trial.

If you wish to complain about any aspect of the way in which you have been approached or treated during the course of this study, you should contact Research Student, Jose Hernandez (Tel: 01865 289323) or you may contact the University of Oxford Clinical Trials and Research Governance (CTRG) office on 01865 572224 or the head of CTRG using their email: ctrg@admin.ox.ac.uk

10. What will happen to the results of the research study?

We will publish the results in scientific journals and present them at scientific meetings. Your details will remain strictly confidential, with no personal information being included in any publications.

11. Who is organising and funding the research?

This study is being funded by the University of Oxford and the National Institute for Health Research (NIHR).

12. Who has reviewed this study?

This study has been reviewed by the North Wales Research Ethics Committee (Central & East) (Ref. **13/WA/0238**).

13. Further information and contact details

If you would like more information or if you have any questions about the study you can contact our research team using the details below:

Jose Hernandez, CHIF WELL Study, DPCHS, New Radcliffe House,
Radcliffe Observatory Quarter, Woodstock Road, Oxford. OX2 6GG.
Tel: 01865 289 323 (9am-5pm)Email: jose.hernandez@phc.ox.ac.uk

Invitation letter

Child Fever and Wellness Study

C F Well

Department of Primary Care Health Care Sciences, New Radcliffe House, Radcliffe Observatory Quarter, Oxford OX2 6GG

Tel: 01865 289323

E-mail: jose.hernandez@phc.ox.ac.uk

Research Student: Jose Hernandez

Invitation to take part in Child Fever and Wellness Study: Parental understanding of temperature measurements and fever care in their children – Focus group interview

The Department of Primary Care Health Care Sciences at the University of Oxford is studying parental understanding of fever and the methods parents use to lower children's temperature.

We are inviting one or two groups of 6 to 10 parents with children up to 5 years of age to be part of a focus group interview. This will help us learn about parental knowledge, beliefs and practices on the management of fever and temperature taking in children under five years. Becoming part of this study may help you to better understand a child's fever and take care of it.

If, after reading the information sheet that came with this letter, you would like to take part in this research study please complete the contact details form attached and introduce it through the mail slot of the sealed box next to the poster of this study. Using your contact details, I will call you at a later date to arrange the time and venue for the focus group interview should you be selected for the study. Please take as long as you require before considering your participation in the study.

Yours faithfully,

Jose Hernandez

Contact details form

Department of Primary Care Health Sciences
Department of Primary Care Health Care Sciences,
New Radcliffe House, Radcliffe Observatory Quarter, Oxford, OX2 6GG
Tel: 01865 5289323

Study Title: Parental and carer understanding of temperature measurements and fever care in children
Short Title: CHIF WELL
Investigator: Jose Hernandez
REC Reference: 13/WA/0238
Participant ID: __ __ __ __

Contact Details

1. I agree to my contact details being collected and used to contact me for the study to understand parental and carer knowledge of fever management and temperature taking (CHIF WELL study). ☐

Name: _____

Address: _____

_____

Email: _____

Telephone Number: _____

_____ _____ _____

Name of Participant Signature of Participant Date

Consent Form

Department of Primary Care Health Sciences
Department of Primary Care Health Care Sciences,
New Radcliffe House, Radcliffe Observatory Quarter, Oxford, OX2 6GG
Tel: 01865 5289323

Study Title: Parental understanding of temperature measurements and fever care in their children
Short Title: CHIF WELL
Investigator: Jose Hernandez
REC Reference:
Participant ID: __ __ __ __

Consent Form- Focus Group

		PLEASE INITIAL
1.	I confirm that I have read and understand the Participant Information Sheet version __ __ dated __/____/____ for the above study. I had the opportunity to read the information, ask questions and have had these questions answered to my satisfaction.	☐
2.	I understand that I am voluntarily participating and that I am free to withdraw at any time, without giving reason, and without my medical care or legal rights being affected.	☐
3.	I understand that the data collected for the study will be looked at by individuals from the University of Oxford responsible for this project and from my local NHS trust. I permit these individuals access my data.	☐
4.	I understand that I will be asked to attend a focus group meeting where we will discuss current guidelines for temperature monitoring and fever care.	☐
5.	I understand that my contact details need to be collected in order to organise the focus group meeting, but that these will be anonymised once used. I consent to these details being collected and used for this purpose.	☐
6.	I agree to the digital recording of the focus-group session and notes being taken during the course of the session for use in the study.	☐
7.	I agree for anonymous quotations from things that I say during the focus group meeting to be used in papers published from this research in scientific journals.	☐
8.	I agree to take part in this study.	☐

_____ _____

_____

Name of Participant	Signature of Participant	Date
_____	_____	_____
Name of Person Taking Consent	Signature of Person taking Consent	Date

Please keep one copy in the patient notes, give one copy to the Participant and send one to the University of Oxford

4.3 Interview schedule

A) Questions used in the semi-structured interviews

1) Understanding of temperature measurement

   Do you have a thermometer or feel comfortable using one?
   Do you know how to do an accurate measurement?

2) Identifying a febrile child
   How do you know when the child you care for has a fever?
   Are there any other signs that you may identify when your child has a fever?

3) Beliefs about fever
   What are your thoughts when the child you care for has a fever?
   Are you worried about the height or length of fever?
   Has this changed as the child you care for has grown older - or with successive children?

4) Managing fever
   How do you manage the child you are caring for when he/she has a fever?
   Who will you contact first if the child you are caring for has a fever?

5) Fever knowledge
   What do you know about fever?
   Do you think fever can have any benefits?
   Do you think fever can be harmful?
   Why?
   How long a fever last?

6) Learning to manage fever
   How did you learn to look after a child with fever?
   What information you think you need to manage fever better in the child you are caring for?
   Will you use other resources?

7) "Closing the circle" the investigator/facilitator will go around asking for closing statements from each one of the participants i.e. would you like to add anything else?

B) Codes and contact summary sheets

Codes

Experience and knowledge of fever

Experiences and beliefs about fever - Parental thoughts and beliefs about fever in children.

Beliefs about fever with older or successive children - Parental thoughts and beliefs about fever as children become older or when having more than one child.

Knowledge about fever and its cause – Parental Knowledge, beliefs and skills about fever in children.

Harms or benefits from fever – Parental understanding of positive or negative outcomes from fever in children.

How long fever can last – Parental perception of different lengths of fever in children.

Management of fever

Conflicting fever management advice - Contradictory and disagreeing advice given to parents from different sources on the management of their child's fever.

*Contact someone else about your child's fever – People or sources of information parents utilise in the case of fever in children.

Fever management – Parental care of fever in children.

How did you learn to manage a fever – Sources of information parents have learnt to manage a fever from.

Identifying a febrile child – Behavioural symptoms and physical signs parents describe when they try to establish a fever in a child.

Identifying disease - Behavioural symptoms and physical signs parents describe when they try to identify disease in a child.

*Out-of-hours care access – Parental source of information or access to care for children when GP practices are closed.

What information you need to manage a fever better – Parental beliefs of information sources they need in order to better understand and manage a fever in children.

*Who to contact first when your child has a fever – First parental contact point in case children have a fever.

Worried about height and length of fever – Parental worries about the height and length of fever in children.

* Topics with some similar content

Thermometry

Comfortable using a thermometer – Parents feeling of comfort and confidence when using a thermometer in children.

*Knowing how to do an accurate measurement – Parents understanding of how to correctly perform a measurement with a thermometer in children.

Owning a thermometer – Parents owing a thermometer.

*Understanding how to use a thermometer – Parents beliefs about the correct use of a thermometer and which sites to use it on in children.

* Topics with some similar content

Contact summary sheets

Contact summary sheet Focus group interview 1

Contact type: Focus group interview 1

Site: Department of Primary Care Health Sciences

University of Oxford

Radcliffe Observatory Quarter

Woodstock road

Oxford

OX2 6GG

Date of contact: 12/11/13

Today's date: 13/12/13

Author: J H

Main issues or themes that strike you in this contact: Parents came eager to the focus group as they wanted to learn about fever and its care in their children. However, some parents needed to be empowered in order to increase their engagement at the initial stages of the interview. One mother expressed to be worried whenever she thought her child had a fever (regarding of length or height).

Summary of the information obtained: Parents did not seem to understand which thermometers were recommended to measure temperature or which site/s should be used for the measurement/s. They identified symptoms of disease through physical signs and behaviour. Fever was considered to be harmful, however, some doubt was raised about whether it could be beneficial in "kind of fighting infection". Healthcare staff and family were the first information points for parents when fever or diseases occurred.

Another salient or interesting points: Some parents expressed concerns about conflicting advice given by different GPs, some GPs provided fever management recommendations which contradicted others GP's advice. Some parents believed this information to be wrong or not up-to-date i.e. giving children cold bath in the occurrence of fever.

New or remaining target questions: Explore further whether parents would like further information about fever management.

Contact summary sheet Focus group interview 2

Contact type: Focus group interview 2

Site: Department of Primary Care Health Sciences

University of Oxford

Radcliffe Observatory Quarter

Woodstock road

Oxford

OX2 6GG

Date of contact: 12/11/13

Today's date: 13/12/13

Author: J H

Main issues or themes that strike you in this contact: Even though parents were offered the opportunity to get free child care three of them opted to bring their children (4 children). This created some disruptions in the smooth running the focus group interview.

Summary of the information obtained: Not all parents seemed to be comfortable using a thermometer but tried to rely on the devices. Parents tried to identify disease and fever through behavioural and physical signs in children. Feverish illness was still a worry; however there was a clearer view of potential benefits from elevated body temperature towards fighting infection than in the previous focus group interview. Family and healthcare staff were the first information point for parents when fever or diseases occurred.

Another salient or interesting points: All parents agreed they would like to have more information to identify disease in children. Conflicting GP advice is a still a parental concern.

New or remaining target questions: Further exploration of topics.

Focus group interview 1

The first focus group interview was formed by four parents. Initially one of the parents was more reluctant to talk but as focus group interview progressed she became more involved.

Focus group interview 2

The second focus group interview was formed by 5 parents. All 5 parents were involved; however the children they brought created some disruption in the smooth functioning of the session.

4.4 Email correspondence of structural change in the focus group interviews and Favourable ethics opinion

Email correspondence

TRACY BIGGS (BCUHB - Clinical Governance) [TRACY.BIGGS@wales.nhs.uk]

Actions
To: Jose Hernandez
Inbox 06 June 2013 12:57

Hi Jose,

I've forwarded this on to Alex.

Best wishes,
Tracy.

Jose Hernandez

Sent Items
06 June 2013 12:47
Dear Tracy,

Hope you are well,

Following yesterday's conversation with Professor Carson, I took his advice on board.

There will not be a discussion on the current guidelines but talking to parents how they currently manage fever; their current actions fears and motivations. I will use and apply the following topic guide to amend all my documents. Please feel free to pass it onto him.

Many thanks,
Jose

To:
Jose Hernandez
Cc:
'Alex Carson' [a.carson@glyndwr.ac.uk]
Inbox
29 May 2013 09:25

This message was sent with High importance.

You replied on 29/05/2013 10:57.
Jose,

My name is Kathy Collins and I am the Lead Reviewer from the North Wales, East & Central REC, for your application, Parental Knowledge and care of fever in children under five.

I am afraid that we have some concerns with your application as it stands. These are outlined below and I would be grateful if you could respond before the committee meets at 8.30 am on Thursday 30 May.

1. The purpose of the study is not clear. Is it to research parents understanding of fever care or to evaluate the NICE guidance/leaflet?
2. The GP practices to be involved are not specified and there is no protocol for approaching GP practice to participate. You as the researcher are expecting a lot of work from busy GPs and we need firm assurance that they are willing to undertake this work. There may be better and more effective ways of distributing questionnaires and approaching potential focus group participants.

3. The recruitment process is very unclear and varies even within the Protocol itself (sections 3 & 4). The poster you mention is not provided. We cannot understand how
one researcher, yourself, can possibly be in every GP waiting room when parents (600 IN TOTAL) are to be approached.
4. Sufficient time is not allowed for considering participation, non urgent so everyone should be given at least 24 hours
5. The Inclusion/exclusion criteria do not recognise complexity of families and care of under 5s, eg. You include only parent living with a child, yet the questionnaire specifically mentions "parents and carers", Question 11 in the Questionnaire does not ask for Civil Partnership. How will you know who is completing questionnaire?
6. Questionnaire is not validated
7. Sample size very small and assumes 50% return rate when a more realistic estimate is 25 -30%
8. Consent form not needed for questionnaire completion is considered to be consent
9. A27-4 & A28 are answered incorrectly
10. The Participant information sheet, letters etc. will need to be rewritten incorporating the corrections made to recruitment process.

I am sorry if this look daunting but it is important for the Ethics Committee to be assured that your research is safe, ethically sound and follows best research practice. I look forward to hearing from you later today.

Kathy

Kathy Collins
Pastoral Care Manager

Bwrdd Iechyd Prifysgol
Betsi Cadwaladr
University Health Board

Ffôn • Tel: 07557 197153
e-bost • e-mail kathy.collins@wales.nhs.uk

Helpwch arbed papur – oes angen i chi argraffu'r e-bost hwn?
Help save paper - do you need to print this e-mail?

Bwrdd Iechyd Prifysgol Betsi Cadwaladr yw enw gweithredol Bwrdd Iechyd Lleol Prifysgol Betsi Cadwaladr.
Betsi Cadwaladr University Health Board is the operational name of Betsi Cadwaladr University Local Health Board.

Favourable ethics opinion

Part of the research infrastructure for Wales funded by the National Institute for Social Care and Health Research, Welsh Government.
Yn rhan o seilwaith ymchwil Cymru a ariannir gan y Sefydliad Cenedlaethol ar gyfer Ymchwil Gofal Cymdeithasol ac Iechyd, Llywodraeth Cymru
Cynhelir Cydweithrediad Gwyddor Iechyd Academaidd y Sefydliad Cenedlaethol ar
gyfer Ymchwil Gofal Cymdeithasol ac Iechyd gan Fwrdd Addysgu Iechyd Powys

The National Institute for Social Care and Health Research Academic Health Science
Collaboration is hosted by Powys Teaching Health Board

North Wales REC (Central & East)

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Wrexham Technology Park
Wrexham LL13 7YP
Telephone : 01978 726377
E-mail : tracy.biggs@wales.nhs.uk
Website : www.nres.nhs.uk
29 August 2013

Mr Jose Hernandez
Department of Primary Care Health Sciences
New Radcliffe House Radcliffe Observatory Quarter
Woodstock road
OX2 6GG

Dear Mr Hernandez

Study title: Developing a theoretical framework for an intervention to improve parental and carer performance on temperature measurement, fever care and knowledge of feverish illness in children

REC reference: 13/WA/0238

Protocol number: JH/CHIFWELL/2013

IRAS project ID: 137547

Thank you for your letter of 19 August 2013, responding to the Committee's request for further information on the above research and submitting revised documentation.

The further information was considered by a sub-committee of the REC at a meeting held on 29August 2013. A list of the sub-committee members is attached.

We plan to publish your research summary wording for the above study on the NRES website, together with your contact details, unless you expressly withhold permission to do so. Publication will be no earlier than three months from the date of this favourable opinion letter. Should you wish to provide a substitute contact point, require further information, or wish to withhold permission topublish, please contact the Co-ordinator Mrs Tracy Biggs, Tracy.Biggs@wales.nhs.uk.

Confirmation of ethical opinion

Members agreed that the provision of a stamped addressed envelope in the information pack could significantly improve the questionnaire response rate. On behalf of the Committee, I am pleased to confirm a favourable ethical opinion for the above research on the basis described in the application form, protocol and supporting documentation as revised, subject to the conditions specified below.

Ethical review of research sites

NHS sites

The favourable opinion applies to all NHS sites taking part in the study, subject to management permission being obtained from the NHS/HSC R&D office prior to the start of the study (see "Conditions of the favourable opinion" below).

Non-NHS sites

Conditions of the favourable opinion

The favourable opinion is subject to the following conditions being met prior to the start of the study.

Management permission or approval must be obtained from each host organisation prior to the start of

the study at the site concerned.

Management permission ("R&D approval") should be sought from all NHS organisations involved in the study in accordance with NHS research governance arrangements.

Guidance on applying for NHS permission for research is available in the Integrated Research Application System or at http://www.rdforum.nhs.uk.

Where a NHS organisation's role in the study is limited to identifying and referring potential participants to research sites ("participant identification centre"), guidance should be sought from the R&D office on the information it requires to give permission for this activity.

For non-NHS sites, site management permission should be obtained in accordance with the procedures of the relevant host organisation.

Sponsors are not required to notify the Committee of approvals from host organisations

It is the responsibility of the sponsor to ensure that all the conditions are complied with before the start of the study or its initiation at a particular site (as applicable).

Approved documents

The final list of documents reviewed and approved by the Committee is as follows:

Document Version Date

Advertisement 2.1 14 August 2013

Covering Letter 10 June 2013

Covering Letter 14 August 2013

Evidence of insurance or indemnity 03 August 2012

Interview Schedules/Topic Guides 1.0 29 January 2013

Investigator CV 04 July 2013

Investigator CV 04 July 2013

Investigator CV 04 July 2013

Letter from Sponsor 11 July 2013

Letter of invitation to participant 2.0 14 August 2013

Letter of invitation to participant 2.0 14 August 2013

Other: FG non-selection letter 1.0 14 August 2013

Participant Consent Form: Focus Group 1.0 29 January 2013

Participant Information Sheet: Questionnaire 2.0 14 August 2013

Participant Information Sheet: Focus Group 2.0 14 August 2013

Protocol 2.1 14 August 2013

Questionnaire 2.0 04 July 2013

REC application 2 24 July 2013

Referees or other scientific critique report 04 July 2013

Response to Request for Further Information 19 August 2013

Summary/Synopsis 1.0 11 April 2013

Statement of compliance

The Committee is constituted in accordance with the Governance Arrangements for Research Ethics Committees and complies fully with the Standard Operating Procedures for Research Ethics Committees in the UK.

After ethical review

Reporting requirements

The attached document *"After ethical review – guidance for researchers"* gives detailed guidance on reporting requirements for studies with a favourable opinion, including:

· Notifying substantial amendments

· Adding new sites and investigators

· Notification of serious breaches of the protocol

· Progress and safety reports

· Notifying the end of the study

The NRES website also provides guidance on these topics, which is updated in the light of changes in

reporting requirements or procedures.

Feedback

You are invited to give your view of the service that you have received from the National Research Ethics Service and the application procedure. If you wish to make your views known please use the feedback form available on the website.

Further information is available at National Research Ethics Service website > After Review

13/WA/0238 Please quote this number on all correspondence

We are pleased to welcome researchers and R & D staff at our NRES committee members' training days – see details at http://www.hra.nhs.uk/hra-training/

With the Committee's best wishes for the success of this project.

Yours sincerely

Professor Alex Carson
Chair
E-mail: tracy.biggs@wales.nhs.uk
Enclosures: List of names and professions of members who were present at the meeting and those who submitted written comments
"After ethical review – guidance for researchers"
Copy to: Ms Heather House
Dr Lorna Henderson, Oxfordshire PCT

North Wales REC (Central and East)
Attendance at Sub-Committee of the REC meeting on 29 August 2013
Committee Members:

Name Profession Present Notes
Professor Alex Carson
Chair
Associate Dean
(Research)
Yes
Dr Kath Clarke Deputy Associate Chief
of Staff, Nursing
Yes
Reverend Kathy Collins Chaplain /Lay Member Yes
Mr Philip Richards Associate Specialist -
Surgery
Yes

Also in attendance:
Name Position (or reason for attending)
Mrs Tracy Biggs Research Ethics Committee Co-ordinator

Appendix Chapter 5

5.1 Establishments by location

Pharmacies (P) and shops (S)

Headington, Marston and Blackbird Leys

1 - (P) Barton Pharmacy, 6 Underhill Circus

2 - (P) Boots, 96 London Road

3 - (P) Boots, Bury Knowle Health Centre, 207 London Road

4 - (P) Manor Pharmacy, 57 Osler Road

5 - (P) Marston Pharmacy, 11 Old Marston Road

6 - (P) Northway Pharmacy, 53 Westlands Drive

7 - (P) Roundway Pharmacy, 3 The Roundway

8 - (P) Rowlands Pharmacy, 13 Atkyns Road, Wood Farm (same as Proctor's Pharmacy, 13 Atkyns Road)

9 - (P) Lloyds Pharmacy, 100 Blackbird Leys Rd

10 - (P) Boots Midnight Pharmacy, Oxford Retail Park

11 - (P) Boots, 96 London Rd

12 - (P) Boots, 207 Barry Knowle Health Centre

13 - (P) Pharmacy John Radcliffe Hospital (out of order)

Nuffield Orthopaedic Centre (no pharmacy)

14 - (P) Churchill Hospital (prescription only pharmacy)

15 - (P) Warneford Hospital (only drugs sent to patients by prescription)

1- (S) Waitrose, 9 - 11 Old High St

2 - (S) Tesco, Unit 7 Oxford Retail Park

Summertown (and Woodstock Rd)

16 - (P) Boots, 221 Banbury Road

17 - (P) Rowlands Pharmacy, 227 Banbury Road

3 - (S) Sainsbury's, Heyford Hill

Botley Rd

4 - (S)Toys are Us, Trading Estate, Botley Rd

4 - (P) Lloyds Pharmacy, 3-4 The Square, Botley Rd

5 - (P) Chemis Pharmacy, Botley Rd

Cowley

18 - (P) Rowlands Pharmacy, 17 Ivy Close

19 - (P) The Leys Pharmacy, Dunnock Way

20 - (P) Boots, 151A Cowley Road

21 - (P) Boots, 20 Templars Square Cowley

22 - (P) Midnight Pharmacy, 150 *Oxford* Road

23 - (P) Lloyds pharmacy, 158 Oxford Rd

5 - (S) Tesco, 159-161 Cowley Rd

Oxford City Centre

24 - (P) Boots, 6-8 Cornmarket St

25 - (P) Superdrug, 11 Market St

26 - (P) Boswell' of Oxford, 1-4 Broad St

27 - (P) Woodstock Chemist, 59 Woodstock Road

28 - (P) Lloyds pharmacy, 116 Walton St

6 - (S) Tesco, 9 Magdalen Street

7 - (S) Sainsbury's, 7 Magdalen St Oxford

8 - (S) Sainsbury's , 21 Westgate Oxford

9 - (S) Tesco Metro, 159-161 Cowley Rd

10 - (S) Sainsbury's, 1-8 St Clement's St

11 - (S) Sainsbury's, 134 Cowley Rd

5.2 Thermometer information with a score between 1 to 4

Type of thermometer	No. devices	Score
Digital thermometer	21	1
Digital thermometer	8	2
Forehead thermometer	9	1
Forehead thermometer	9	2
Infrared behind ear thermometer	1	1
Infrared thermometer	8	1
Infrared thermometer	4	2
Infrared thermometer	1	3
Infrared thermometer non-contact	1	1
Infrared thermometer non-contact	1	3

Appendix Chapter 6

6.1 Socio demographic data as supplied from practices and out-of-hours

27 Beaumont Street

Age	Males	Females
00-09	223	219
10-19	418	418
20-29	1291	1080
30-39	542	456
40-49	319	298
50-59	279	243
60-69	228	193
70-79	130	108
80-89	56	56
90-99	7	19
100+	0	0

28 Beaumont Street

Age	Males	Females
00-09	122	110
10-19	282	301
20-29	916	812
30-39	400	330
40-49	253	163
50-59	186	154
60-69	133	131
70-79	102	76
80-89	31	44
90-99	8	19
100+	0	0

Abingdon and Witney out-of-hours

Age range	Sex	Patient Count
0-9	Female	3263
0-9	Unknown	9
0-9	Male	3609
10-19	Unknown	5
10-19	Female	1252
10-19	Male	850
100 +	Female	51
100 +	Male	17
20-29	Female	2239
20-29	Male	1084
20-29	Unknown	7
30-39	Female	2075
30-39	Male	1075
30-39	Unknown	10
40-49	Unknown	5
40-49	Female	1621
40-49	Male	1118
50-59	Female	1292
50-59	Male	1025
50-59	Indeterminate	1
50-59	Unknown	7
60-69	Unknown	7
60-69	Female	1224
60-69	Male	970
70-79	Female	1174
70-79	Male	983
70-79	Unknown	2
80-89	Male	1056
80-89	Female	1513
80-89	Unknown	1
90-99	Male	370
90-99	Female	742
90-99	Unknown	1

6.2 PIS, invitation letter and questionnaire

PIS





C F Well

Child Fever and Wellness  **Study**

Questionnaire Participant Information Sheet

Parental and carer understanding of temperature measurements and fever care

You are being invited to take part in a research study.

This information sheet explains why the research is being conducted and what will happen if you decide to take part.

Please read it carefully and talk to others about the study if you wish. Please ask if there is anything that is not clear or if you would like more information.

Please take your time to decide whether you wish or not to take part in the study.

7. What is the purpose of this study?

This study is being done to learn more about how much parents and carers know about temperature measurements, fever and its care in children. We want to find out about parental and carer knowledge and management of children when they have a fever. This study will bring new light in the understanding of parental and carer management and knowledge of fever in children aged 5 years or less as there has been very limited and outdated research in the area.

8. Why have I been invited?

You have been invited because you are a parent or carer of a child aged 5 years or less. The child you are caring for may or may not have a high temperature at the moment, we want to find out about parental and carer knowledge about high temperatures. We are aiming to recruit least 271 parents and carers to participate in our study. This research is being undertaken as part of as an educational project as fulfilment for an academic qualification.

9. Do I have to take part?

It is you choice to take part in the study. We will describe the study and go through this information sheet. If you agree to take part, complete questionnaire as consent. If you decide not to take part in the study you may withdraw without giving a reason, this will not affect your future care.

10. What will happen to me if I take part?

In this study we are asking parents and carers to complete a questionnaire about what they know about high temperatures in young children and the methods parents and carers use to lower children's temperature.

The questionnaire will take approximately 10 minutes to complete and will ask you about your knowledge about high temperatures, your knowledge of how to take a temperature and about how you treat the child you are caring for if he/she has a high temperature.

If, once you have read through the information, you are willing to take part in the study you may fill in the questionnaire attached to this form. You may take as long as you need to fill in the questionnaire. There will be one or two empty sealed boxes that you can find in the waiting room of you practice together with the poster of this study, these boxes have a mail slot where you can place your questionnaire safely. Once you have left the completed questionnaire in the box it will conclude your participation in the study.

11. What are the disadvantages or benefits of taking part?

Taking part may help us improve the information that parents and carers are given about temperature measurements and fever. It may also help participants to better understand what a fever is and simple measures of how to take care of a child if it occurs. We do not anticipate that there are any disadvantages in taking part, only the additional time it takes to complete the questionnaire.

12. Will my taking part in this study be kept confidential?

Yes. Your questionnaire will be assigned an ID number and no further details will be required from you. All the information from the questionnaire and consent form will be kept securely according to the Data Protection Act 1998. The data collected for the study may be looked at by individuals from the University of Oxford and from the local NHS trust to ensure we are complying with regulations.

13. What will it happen if I don't want to carry on with the study?

We will collect no further information from you, but any information you have given to the Research Student will be kept as part of the study unless you request that it is deleted. Leaving the study will not affect your or your child's continued care in anyway.

14. What if there are any problems?

Given the nature of this study, it is highly unlikely that you will suffer harm by taking part. However, the University of Oxford, as Sponsor, has appropriate insurance in place in the unlikely event that you suffer any harm as a direct consequence of your participation in this trial.

If you wish to complain about any aspect of the way in which you have been approached or treated during the course of this study, you should contact Research Student, Jose Hernandez (Tel: 01865289323) or you may contact the University of Oxford Clinical Trials and Research Governance (CTRG) office on 01865 572224 or the head of CTRG, email ctrg@admin.ox.ac.uk

15. What will happen to the results of the research study?

We will publish the results in scientific journals and present them at scientific meetings. Your details will remain strictly confidential, with no personal information being included in any publications.

16. Who is organising and funding the research?

This study is being funded by the University of Oxford and the National Institute for Health Research (NIHR).

17. Who has reviewed this study?

This study has been reviewed by the North Wales Research Ethics Committee (Central & East) (Ref. **13/WA/0238**).

18. More information and contact details

If you would like more information or if you have any questions about the study you can contact our research team on the details below:

Jose Hernandez, CHIF WELL Study, DPCHS, New Radcliffe House,
Radcliffe Observatory Quarter, Woodstock Road, Oxford. OX2 6GG.
Tel: 01865 289 323 (9am-5pm)
Email: jose.hernandez@phc.ox.ac.uk

Invitation letter

Child Fever and Wellness Study

C F Well

Department of Primary Care Health Care Sciences,

New Radcliffe House, Radcliffe Observatory Quarter, Oxford, OX2 6GG

Tel: 01865 289323,

E-mail: jose.hernandez@phc.ox.ac.uk

Research Student: Jose Hernandez

Invitation to take part in Child Fever and Wellness Study: Parental and carer understanding of temperature measurements and fever care in their children - Questionnaire

The Department of Primary Care Health Care Sciences at the University of Oxford is studying parental and carer understanding of fever and the methods parents and carers use to lower children's temperature.

We are inviting at least 271 parents and carers of children of 5 years of age or less to complete a questionnaire about their understanding of fever in young children. This will help us to comprehend what parents and carers know and do when a child they care for has a fever. Becoming part of this study may help you to better understand your child's fever and take care of it.

If after reading the information sheet that came with this letter you would like to take part in this research study, please fill in the questionnaire attached and introduce it through the mail slot one of the sealed box next to the poster of this study. Please take as long as you require to considering filling in the questionnaire.

Yours sincerely,

Jose Hernandez

Questionnaire

Participant ID: __ __ __

Please note that in the questionnaire acetaminophen refers to paracetamol

C  F Well

Child Fever and Wellness Study

Parents' and carers' perceptions and knowledge of temperature measurements and fever in children

This study aims to understand parental and carer knowledge of temperature measurements and fever in children less than 5 years of age.

- The following questionnaire should take 10 minutes to complete.

- If you feel that any of the questions are inappropriate, please do not feel that you have to answer them.

- If after completing these questions, you want to add some more information, there is space for further comments.

- All information will remain confidential to the research team if you have any questions you can call Jose Hernandez in the department of Primary Health Care Sciences at the University of Oxford, at Oxford University on 01865 289323.

Thank you for your time in completing this questionnaire. Version 2.0

For administration only	
Date received	Data entry

Section 1: Details about you

Please complete the following details about yourself. All information given will remain confidential

1. Date of birth: _____
2. Sex: ☐ Female ☐ Male
3. Number of children you care for: ☐ 1 ☐ 2 ☐ 3 or more
4. How old are the children? Please state: _____
5. Marital Status? (please tick one box)
   - ☐ Single (never married)
   - ☐ Married or living with a partner
   - ☐ Divorced or separated
   - ☐ Widowed
   - ☐ Civil partnership
   - ☐ Other, please describe_____
6. Which best describes your current work situation? (please tick one box)
   - ☐ Full-time paid work (including self-employment)
   - ☐ Retired
   - ☐ Part-time paid work (including self-employment)
   - ☐ Looking after home/family

☐ Unable to work

☐ Student

☐ Unemployed

Section 2: Questions about Temperature Management

1. What do you consider a "high" temperature?

   _____°C

2. If the child you care for had a fever and you didn't treat it with ibuprofen (Calprofen) or acetaminophen (Calpol), how high do you think it could go?

   _____°C

3. In your opinion, what is the greatest harm that high fever can cause to a child?

   _____

4. How low a temperature can cause the types of harm you listed in question 3?

   _____

5. How worried are you about the effect fevers can have?

   _____

6. If the child you care for has a fever, how often do you continue to take his/her temperature?

   _____

7. Above what temperature do you give ibuprofen (Calprofen) or acetaminophen (Calpol)?

_____°C

8. How often do you give ibuprofen (Calprofen) or acetaminophen (Calpol) for fever?

_____

9. If the child you care for has fever when you put him/her down for the night, do you awaken him or her during the night to give ibuprofen (Calprofen) or acetaminophen (Calpol)?

_____
_

10. Will you use any other methods to treat a Child's fever?

_____

11. Where did you learn your ideas about fever management from? Please tick any and all that apply

☐ GP

☐ Nurse

☐ Friends/relatives

☐ Read/internet

☐ Other *please specify*

_____

12. Have you ever used a thermometer to take a child's temperature?

☐ Yes ☐ No

13. What kind of thermometer/s do you have at home? Please note that your thermometer may look different from the example photos below. Tick all boxes that might apply

☐ Digital thermometer 

☐ Mercury-in-glass thermometer 

☐ Forehead chemical thermometer 

☐ Infrared thermometer (e.g. ear) 

☐ Forehead thermometer 

☐ Other *please describe* _____

☐ I don't have a thermometer

14. How did you learn how to read a thermometer? Please tick all boxes that apply.

☐ Thermometer instructions

☐ GP

☐ Friends, family

☐ Healthcare staff (e.g. Nurses, healthcare assistant etc…)

☐ Other *please describe*_____

15. At what temperature would you take a baby younger than 3 months to a GP practice or an out-of-hours service?

Please circle the temperature that applies.

35°C 35.5° 36°C 36.5°C 37°C 37.5°C 38°C 38.5°C 39°C
_____|_____|_____|_____|_____|_____|_____|_____|_____

16. At what temperature would you take a baby between 3 and 6 months to a GP practice or an out-of-hours service?

Please circle the temperature that applies.

35°C 35.5° 36°C 36.5°C 37°C 37.5°C 38°C 38.5°C 39°C
_____|_____|_____|_____|_____|_____|_____|_____|_____

17. The last time the child you care for had a fever how did you try to lower it? E.g. gave ibuprofen (Calprofen) or paracetamol (Calpol). Please tick all that might apply.

☐ Gave paracetamol alone

☐ Gave ibuprofen alone

☐ Paracetamol and ibuprofen at the same time

☐ Paracetamol and ibuprofen alternately

☐ Nothing

☐ Other *please describe*_____

18. Will you offer a child regular drinks when he/she has a fever?

☐ Yes ☐ No ☐ I don't know

If yes, *please describe*_____

Section 3: Please use the space below to tell us about anything that you feel we have not covered in this question

6.3 Coding for analysis

No. of children	1	1	**Concern**	No worried	1	**Frequency of measurement**	Every 2 hours or less	1
	2	2		Not too worried	2		Every 2 to 4 hours	2
	3 or more	3		Worried	3		Every 4 hours	3
				Very worried	4		Every 4 to 6 hours	4
							Every 6 to 8 hours and above	5

6.4 Coding from participants comments

FEVER KNOWLEDGE

Fever sign of illness

Worried about fever

Fever is not dangerous

Older or second child

MANAGEMENT OF FEVER

Management of fever

Receives instruction from family

Wife deals with the child

KNOWLEDGE OF TEMPERATURE MEASUREMENT

Knowledge of temperature measurement

Discrepancy of measurement in different body parts

QUESTIONNAIRE

Suggestions for the questionnaire

Ask for extra information

Questionnaire useful

6.5 Cross tabulation of High Temperature def. (°C) (Question1) and at what temperature (°C) would you take a baby younger than 3 months to a GP practice or out-of-hours? (Question15)

			At what temperature (°C) would you take a baby younger than 3 months to a GP practice or out-of-hours?											
			35	36	36.5	37	37.2	37.5	37.7	38	38.5	39	40	Total
1) High Temperature (°C)	30	Count	2	0	0	0	0	0	0	0	0	0	0	2
		% of Total	.8%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.8%
	34	Count	1	0	0	0	0	0	0	0	0	0	0	1
		% of Total	.4%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.4%
	35	Count	0	1	1	0	0	0	0	0	0	0	0	2
		% of Total	.0%	.4%	.4%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.8%
	36	Count	1	2	1	1	0	0	0	1	0	0	0	6
		% of Total	.4%	.8%	.4%	.4%	.0%	.0%	.0%	.4%	.0%	.0%	.0%	2.4%
	37	Count	2	1	1	12	0	4	0	8	0	1	0	29
		% of Total	.8%	.4%	.4%	4.9%	.0%	1.6%	.0%	3.2%	.0%	.4%	.0%	11.7%
	37.2	Count	0	0	0	1	0	0	0	0	0	0	0	1
		% of Total	.0%	.0%	.0%	.4%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.4%
	37.4	Count	0	0	0	0	0	1	0	0	0	0	0	1
		% of Total	.0%	.0%	.0%	.0%	.0%	.4%	.0%	.0%	.0%	.0%	.0%	.4%
	37.5	Count	0	0	0	2	0	9	0	9	2	1	0	23
		% of Total	.0%	.0%	.0%	.8%	.0%	3.6%	.0%	3.6%	.8%	.4%	.0%	9.3%
	37.6	Count	0	0	0	0	0	1	1	1	0	0	0	3
		% of Total	.0%	.0%	.0%	.0%	.0%	.4%	.4%	.4%	.0%	.0%	.0%	1.2%
	37.7	Count	0	0	0	1	0	0	0	0	0	0	0	1
		% of Total	.0%	.0%	.0%	.4%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.4%
	37.8	Count	0	0	1	1	1	1	0	1	0	1	0	6
		% of Total	.0%	.0%	.4%	.4%	.4%	.4%	.0%	.4%	.0%	.4%	.0%	2.4%

	38	Count	1	1	2	7	0	14	0	46	8	8	1	88
		% of Total	.4%	.4%	.8%	2.8%	.0%	5.7%	.0%	18.6%	3.2%	3.2%	.4%	35.6%
	38	Count	0	0	1	0	0	0	0	1	2	0	0	4
		% of Total	.0%	.0%	.4%	.0%	.0%	.0%	.0%	.4%	.8%	.0%	.0%	1.6%
	38.5	Count	0	0	0	0	0	1	0	3	7	2	0	13
		% of Total	.0%	.0%	.0%	.0%	.0%	.4%	.0%	1.2%	2.8%	.8%	.0%	5.3%
	38.6	Count	0	0	0	0	0	0	0	0	1	0	0	1
		% of Total	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.4%	.0%	.0%	.4%
	38.8	Count	0	0	0	0	0	0	1	0	0	0	0	1
		% of Total	.0%	.0%	.0%	.0%	.0%	.0%	.4%	.0%	.0%	.0%	.0%	.4%
	39	Count	0	2	0	2	0	6	0	14	13	13	0	50
		% of Total	.0%	.8%	.0%	.8%	.0%	2.4%	.0%	5.7%	5.3%	5.3%	.0%	20.2%
	40	Count	0	0	0	0	0	1	0	7	2	4	0	14
		% of Total	.0%	.0%	.0%	.0%	.0%	.4%	.0%	2.8%	.8%	1.6%	.0%	5.7%
	43.3	Count	0	0	0	0	0	0	0	0	1	0	0	1
		% of Total	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.4%	.0%	.0%	.4%
Total		Count	7	7	7	27	1	38	2	91	36	30	1	247
		% of Total	2.8%	2.8%	2.8%	10.9%	.4%	15.4%	.8%	36.8%	14.6%	12.1%	.4%	100.0%

Publications

How appropriate is the information about childhood fever in thermometer package inserts? An audit of thermometers in the UK (1st Author publication accepted but not yet online) Jose Hernandez[1], Brian D Nicholson[1], Matthew Thompson[2]

Evidence for non-communicable diseases: analysis of Cochrane reviews and randomised trials by World Bank classification Carl Heneghan et al, (2013), Bmj Open, 3