Published in final edited form as:

J Adv Nurs. 2011 February ; 67(2): 359–370. doi:10.1111/j.1365-2648.2010.05506.x.

Clinical management of fever by nurses: doing what works

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Abstract

Aims—The specific aims were to (1) define fever from the nurse's perspective; (2) describe fever management decision-making by nurses and (3) describe barriers to evidence-based practice across various settings.

Background—Publication of practice guidelines, which address fever management, has not yielded improvements in nursing care. This may be related to differences in ways nurses define and approach fever.

Method—The collective case study approach was used to guide the process of data collection and analysis. Data were collected during 2006–7. Transcripts were coded using the constant comparative method until themes were identified. Cross-case comparison was conducted. The nursing process was used as an analytical filter for refinement and presentation of the findings.

Findings—Nurses across settings defined fever as a (single) elevated temperature that exceeded some established protocol. Regardless of practice setting, interventions chosen by nurses were frequently based on trial and error or individual conventions – ‘what works’ – rather than evidence-based practice. Some nurses' accounts indicated use of interventions that were clearly contraindicated by the literature. Participants working on dedicated neuroscience units articulated specific differences in patient care more than those working on mixed units.

Conclusions—By defining a set temperature for intervention, protocols may serve as a barrier to critical clinical judgment. We recommend that protocols be developed in an interdisciplinary manner to foster local adaptation of best practices. This could further best practice by encouraging individual nurses to think of protocols not as a recipe, but rather as a guide when individualizing patient care. There is value of specialty knowledge in narrowing the translational gap, offering institutions evidence for planning and structuring the organization of care.

Keywords

acute care; adult patients; case study; elevated temperature; evidence-based fever management; fever; nursing

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Conflict of interest

No conflict of interest has been declared by the authors.

Author contributions

HT was responsible for the study conception and design, performed the data collection, obtained funding, provided administrative, technical or material support and supervised the study. HT and SK performed the data analysis, were responsible for the drafting of the manuscript and made critical revisions to the paper for important intellectual content. SK provided qualitative expertise.

Introduction

Fever in patients with neurological insults is associated with poor outcomes (Hajat *et al.* 2000, Natale *et al.* 2000, Thompson *et al.* 2003, Wartenberg *et al.* 2006, Adams *et al.* 2007, Kirkness *et al.* 2008) and should be avoided [Adelson *et al.* 2003, Brain Trauma Foundation/American Association of Neurologic Surgeons (BTF/AANS) 2007]. Despite research that reveals an association between fever and poor outcomes, it is undermanaged in these patients (Albrecht *et al.* 1998, Kilpatrick *et al.* 2000, Thompson *et al.* 2007b). Its management is often left to the discretion of the individual practitioner because evidence-based guidelines are not explicit (Adelson *et al.* 2003, Adams *et al.* 2007, BTF/AANS 2007). In this article, we describe the findings from a study to define fever from the nurses' perspective, describe fever management decision-making and barriers to evidence-based practice (EBP) among nurses practising across various settings that care for patients with neurological insults. As neurotrauma is expected to become the third leading cause of death and disability worldwide (World Health Organization 2008), appropriate nursing management of these patients will become increasingly important.

Background

Fever is a normal, coordinated response of the body to a perceived threat to the immune system, which includes autonomic, behavioural and neuroendocrine responses (Thompson *et al.* 2003). As part of this response, an elevated temperature occurs in response to endogenous stimuli to allow for improved functioning of the immune system (Cooper 1995, 2002). In most patients, fever is advantageous and does not require intervention. In certain populations, such as those with neurological insults, fever is associated with poor outcomes (Wartenberg *et al.* 2006, Kirkness *et al.* 2008) and should be avoided (Adams *et al.* 2007, Alexander *et al.* 2007, BTF/AANS 2007).

Fever is a common human experience that is assumed to be universally understood. Nevertheless, its clinical interpretation is often remarkably individual and highly variable. Many authors in nursing and medical literature defined fever simply as an elevation of body temperature (Segatore 1992, Cairns & Andrews 2002, Schulman *et al.* 2005, O'Grady *et al.* 2008, High *et al.* 2009, Laupland 2009, Reaven *et al.* 2009). Furthermore, the specific temperature warranting the label of fever varies widely.

Fever in the acute phase following traumatic brain injury (TBI), subarachnoid haemorrhage (SAH) and stroke is associated with unfavourable outcomes for patients. These outcomes include higher mortality rates, increased lengths of stay and decreased functional status (Hajat *et al.* 2000, Kilpatrick *et al.* 2000, Natale *et al.* 2000, Jiang *et al.* 2002, Stocchetti *et al.* 2002, Diringier *et al.* 2004, Greer *et al.* 2008). TBI, SAH and stroke guidelines state that maintenance of normothermia should be the standard of care (Adelson *et al.* 2003, Adams *et al.* 2007, Alexander *et al.* 2007, BTF/AANS 2007). Nurses frequently must manage the problem of fever in these populations as its prevalence is high in the acute phase (Childs *et al.* 2005, McIlvoy 2007, Thompson *et al.* 2007b, Kirkness *et al.* 2008). This management has a direct relevance to clinical outcomes and thus warrants study.

Recent studies reveal wide variation in nursing practice and barriers to evidence-based fever management. In the United Kingdom (UK) and Ireland, the most common sites for temperature measurement in neurological ICU patients were the axilla and groin (Johnston *et al.* 2006), sites not recommended for monitoring temperature in critically ill adults (O'Grady *et al.* 2008). Previous studies in the United States (US) have shown that between 14% and 69% of febrile episodes in patients with neurological insults in the ICU are undertreated (Kilpatrick *et al.* 2000, Thompson *et al.* 2007b). Edwards *et al.* (2007) noted

that Australian paediatric nurses generally consider fever to be a detrimental event requiring intervention with antipyretics. Grossman *et al.* (1995) evaluated nursing practices in the care and management of febrile patients on a mixed medical unit and found that only 59% of patients experiencing fever were treated appropriately by nurses. In studies conducted separately in three different countries (US, Sweden and Australia), all authors noted a lack of consistency in the way nurses described fever and the management of fever (Grossman *et al.* 1995, Emmoth&Mansson 1997, Edwards *et al.* 2001, 2007, Walsh *et al.* 2005). The gap between available evidence from patient outcomes research and data on bedside practice for fever management is a striking, widespread problem.

In the context of high-risk outcomes, there is inconsistency in implementing EBP. As the nurse at the bedside is the primary decision maker on antipyretic interventions when there is an established fever management protocol in place (Emmoth & Mansson 1997, Thompson *et al.* 2007b), we undertook an inductive, qualitative study of nurses' perspectives on fever management and clinical decision-making for patients and specifically for those with a neurological insult.

The study

Purpose statement and specific aims

We sought to understand perspectives of nurses on fever when caring for neurologically vulnerable patients across different settings. This study addressed the questions:

- How do nurses across various practice settings define fever?
- How do nurses determine what (if any) nursing management strategies to initiate in response to fever?
- Are there any barriers to adequate fever management they encounter in their practice?

Design

A collective case study approach was used to identify how nurses across multiple practice settings define fever and subsequently decide how to care for neurologically vulnerable people. The case study method matched the study purpose of characterizing nurses' perspective, definition and management of fever. In addition, the method enabled exploration of factors that influenced nurses' behaviour and knowledge translation (Oeyen 2007) for a depiction of management decisions in a truly illustrative manner.

Participants

Professional nurses who cared for patients with neurological insults on five selected nursing units at two different US hospitals comprised a purposive sample of participants ($N = 17$). Nurses interested in participating were asked to identify themselves for inclusion. Nurses were recruited from both critical care ($n = 11$) and acute care units ($n = 6$), and from both dedicated neuroscience ($n = 6$) and mixed units ($n = 11$). Initially, maximum variation sampling was used until three to four nurses from each unit enrolled to ensure balanced representation across the units. Enrolment ceased when data saturation was achieved.

Protection of participants—Institutional Review Board Approval from the University of Washington was obtained for this study. The study was conducted in accordance with all established university policies for the conduct of research on humans. In addition, each hospital's nursing research committee approved the study. Informed consent was obtained from all nurse participants. Nurse participants were informed that they did not have to

answer every question and that participation was voluntary, confidential, and would not affect employment or performance evaluations. Participants received remuneration in the form of a \$25 gift certificate for their time in participating. Participants were offered the option to review their interview tapes as a member check. A waiver of consent was granted by the institutional IRB for the direct observation of patient care and medical record review.

Data collection

Interviews—After participants identified themselves and informed consent was obtained, tape recorded, semi-structured interviews were conducted in a quiet location convenient to the participants. Questions were developed by the primary investigator based on areas identified from the review of the literature and prior quantitative studies. The list of interview questions underwent pilot testing and refinement before their use in the current study. Sample questions during the interview included ‘how do you personally define fever?’ and ‘how do you decide what interventions to use for fever management?’ The primary investigator used reflective techniques before entering the study settings to bracket her perspective and assumptions about the phenomenon under study.

Direct observation—Direct observation of care delivery by study participants was conducted by the primary investigator on two units (one dedicated and one mixed unit) in the month immediately following completion of interviews. The primary investigator was present on the unit and observed care provided by five participants on normally scheduled day or evening shifts. Only care directly related to temperature assessment and management was of interest. The shift-based observation occurred until care for a febrile episode was observed (10 shifts total).

Field notes were written about the observation and included descriptive information from the patient’s medical record to note nursing documentation of temperature assessment, assessment features that characterized the fever episode and care provided in response to fever. Observation targeted verification of interview data.

Data analysis

Recorded interviews were transcribed verbatim along with detailed field notes of the interviews and observations. Data were managed using the Atlas/ti 5.0 software program (Atlas.ti, Berlin, Germany). Using constant comparative technique, data were initially coded and preliminary categories were developed. Each case was initially analysed separately as data collection progressed. As transcripts were accrued, each interview was iteratively coded until themes were identified. As initial codes were collapsed or axialized, themes emerged. A subset of the cases were independently coded for verification by a trained graduate student. Crosscase comparison based on unit (specialty vs. mixed) was conducted only after individual case analyses were conducted as per the recommendation of Yin (2003). The nursing process (e.g. assessment and analysis, planning and implementation, and evaluation) was used as an analytical filter to refine and present the findings using a clustering approach (Miles & Huberman 1994, Rosenberg & Yates 2007). In this manner, emerging themes and patterns were examined and organized into a descriptive matrix (Rosenberg & Yates 2007).

Rigour

To allow for improved trustworthiness, data collection and analysis followed the three principles identified by Yin (2003): (1) using multiple sources of evidence; (2) creating a case study data base using computer software (Atlas/ti 5.0); and (3) maintaining a chain of evidence. The use of multiple data sources in this study allowed for data source triangulation and improved confirmability and credibility of the analysis (Guba 1981, Yin 2003). Verification was also employed to support credibility. The main study findings were

presented to neuroscience nurses at a national meeting in April 2007 and to acute care nurse educators and researchers at a state of the science meeting in October 2008. These nurses verbally concurred with the study's result, supported its value, and offered no alternative explanations or refutation. The use of nurses from a variety of patient care settings as participants supported trustworthiness by addressing the issue of transferability (Guba 1981).

Findings

Findings were organized using the analytical filter of the nursing process: assessment/analysis, planning/implementation and evaluation.

Assessment/analysis

In the context of assessment/analysis, themes of defining fever, fever vs. hyperthermia and patient assessment were identified (See Table 1 and Table S1). In the theme of 'defining fever', the definition of fever provided by most nurses was a single number or cut point. In all but one case, the temperature cited coincided with hospital protocols or physician orders: 'typically 38.5...because that is how they ordered it' and 'what the medical community does is anything that is above 38.5'. Only after prompting by the interviewer to the question 'Do you think of other symptoms when you think of fever' did participants include other signs/symptoms such as: 'they are warm' 'tachycardia', 'sweat', 'mental status changes', 'respiratory rate' and 'blood pressure'. This finding was confirmed by the review of documentation in the medical record during participant observation. In the context of the theme 'fever vs. hyperthermia', nurses were generally unable to describe how fever differed from hyperthermia regardless of practice setting: 'I think of them as the same...so, I wouldn't be able to distinguish whether someone was hyperthermic or have a fever' (see also Table 1 and Table S1). Furthermore, in the theme of 'patient assessment', thermometer accuracy was seen as a large barrier to assessment as exemplified by the quote: 'as far as I am concerned the machine can be very arbitrary I can get five machines in there and I can probably get five different temperatures' (See also Table 1 and Table S1). Interestingly, participants on dedicated neuroscience units often reported mental status changes or confusion as a sign of fever (Table 1 and Table S1) and noted other specific causes of fever seen in patients with neurological disorders or injury such as a reaction to phenytoin and sympathetic storm. This finding was also confirmed during participant observation, where the presence of a change in level of consciousness prompted temperature assessment. Specific education on fever management was reported by nurses working on dedicated units:

We've gotten...education on treating types of patients differently whether they... had a traumatic brain injury and you know how a fever can be...much worse in them in outcomes versus someone with just a broken leg or skin infection.

Planning/implementation

The themes identified in planning/implementation included rationale for choice of intervention, pharmacological interventions, non-pharmacological interventions, effect of physician, effect of protocol and total body/pan cultures. Many respondents reported doing 'what worked' for the individual patient in the past as rationale for choice of intervention (see also Table 1 and Table S1):

If in the report the nurse before me tells me that they had a fever. I'll ask what did you use, what works? Instead of me wasting my time going through twenty options.

Others responded that they or their colleagues simply followed an available protocol or reported following a series of steps based on their own opinion, experience or philosophy: 'I know there are a lot of people with a certain beliefs, I am kind of [like it] depends on how I

am feeling that day' (see also Table 1 and Table S1). Participants commonly reported using acetaminophen as a common first step: 'First of all I check the order and find out do I have Tylenol', often choosing to use it at a lower temperature threshold for fever than ordered (Table 1 and Table S1). This finding was confirmed during observation where acetaminophen was given by the nurse to treat a fever, but documented as given for pain as the temperature was lower than that for the fever order. Ibuprofen was commonly seen as working better than acetaminophen, but participants reported that it was not always available to them for use. Numerous non-pharmacological interventions were detailed including environmental changes (e.g. removing blankets, turning down thermostat, opening windows), physical cooling measures (e.g. ice packs, cooling blanket, bathing) and other interventions (e.g. mobilization, incentive spirometer use). Furthermore, many interventions seen as useful by some participants (e.g. ice packs, cooling blankets, fans, etc.) were seen as problematic by others (see also Table 1 and Table S1):

cooling blankets...they are just really hard to put them on over the head and [with] central line patient intubated with a ventriculostomy and I was like this is never going to work.... and cooling blankets like explode and they have water going everywhere and obviously this is not helping.... instead, its better to take a few ice packs and a cold towel and I can move those in there...it's not that expensive.

Available protocols were seen as including interventions deemed by many respondents as 'aggressive' or 'extreme' (Table 1 and Table S1). Furthermore, participants reported that some physicians did not treat fever in patients on an individual basis and that follow-up from cultures was poor. This was exemplified by the quote:

sometimes it is frustrating in terms of being able to sort of help [the doctors] to get past writing a thing to do and that's sometimes their idea of addressing a problem as opposed to looking at this patient.

Most participants reported that they did not see a yield from ordered cultures and found them to be both resource- and time-consuming and potentially harmful to patients:

Usually the doctor here wants right away you know...U/A, C&S and stuff like that...so I will just do it...just to make sure...but on the top of my mind...I am telling them the patient... sutures looks good, he is not coughing, he looks okay you know...he looks like he needs some fluids something like that but they still want some cultures you know...cultures and labs...[sigh] (see also Table 1 and Table S1).

Evaluation

Within evaluation were the following themes: time interval for evaluating efficacy, efficacy, patient differences in response and barriers to treatment. A resolution of the patient's temperature to a level below that in the fever protocol was defined as efficacy by participants. The interval for this assessment varied widely among participants, and when one intervention did not work, they would initiate another intervention as exemplified by the quote: 'If it comes down, it comes down. If it doesn't, I keep going until something works'. Paediatric patients were viewed as being very different from adults, and higher thresholds were set for concern. Lastly, while some participants reported no barriers to care, others reported that both the patient and availability of equipment were treatment barriers (Table 1 and Table S1).

Discussion

We sought to understand perspectives of nurses on fever when caring for neurologically vulnerable people across different settings, specifically examining how strategies are

selected and barriers encountered. The study findings suggest that in the absence of protocols developed in an interdisciplinary manner, nurses chose rather to rely on trial and error or individual convention. The study identified that a barrier to care were the decisions made by nurses and their physician colleagues where, they are 'doing their own sorts of things' or what is 'done at home' without regard to EBP. This echoes previous findings from the US and Ireland and the UK where treatment decisions were based on opinion, resulting in dissatisfaction with treatment (Johnston *et al.* 2006) and perception of a barrier to best practice (Thompson *et al.* 2007a). Previous studies have found that collaborative development of protocols is critical for successful adaptation of protocols and for closing the translational gap (Oeyen 2007, Sinuff *et al.* 2007). Therefore, our findings support that fever management protocols need to be developed in collaboration with nursing to ensure best-practice is achieved. Furthermore, while protocols were seen as valuable by many participants in the present study, when not applied in a critical manner, they may also be practice-limiting as individual nurses do not think beyond the protocol to what is best for the individual patient.

These findings suggest that there is a lack of detail in nurses' descriptions of the febrile state and also a lack of consistency in determinations of when patients with fever should be treated. In previous studies, fever was defined by nurses as simply an elevation in body temperature, without further documentation of accompanying signs and symptoms of fever (Grossman *et al.* 1995, Edwards *et al.* 2001). Therefore, it is difficult to ascertain what role, if any, these signs and symptoms played in the decision to treat fever. Nurses caring for patients with a neurological insult who have fever commonly relied on multiple indicators that the patient indeed had a fever. These indications went beyond an elevation in temperature to include assessment findings and signs that may be specific to an individual patient, such as changes in the neurological assessment. These findings are often either not consciously noted or are not presented discursively in nurse–nurse communications (Thompson *et al.* 2007b). As a result, written communication about the patient's unique experience of fever is often absent from the patient record. This could then lead to delayed or inappropriate fever management, which may have a significant impact on patient outcomes for patients with neurological insults. Thus, any ambiguity associated with fever in individual patients and its clinical interpretation have implications for patient care and outcome, particularly in vulnerable populations such as patients with neurological insults.

Participants in the present study noted that at present, the medical record was a barrier to documentation of descriptive findings. Suggestions were made for improvement such as automatic documentation prompts in the electronic medical record. Emmoth and Mansson (1997) asserted that because descriptions of fever are very different, misunderstandings can result, and recommended the identification and use of clarified language in nursing documentation. The use of a prompt system, as suggested by participants in the present study, could provide some clarification.

Our participants reported using interventions not supported by literature such as alcohol, ice packs to the groin and opening the windows in the intensive care unit to treat fever. During the chill phase of fever, use of ice packs is likely to lead to increased shivering as the temperature set point has been raised and the body is working to increase the temperature to the new threshold (Bruderlein *et al.* 2006). This concern is magnified when the ice is applied to the groin area which contains a large number of heat sensitive neurons. The use of alcohol to reduce fever is of unclear efficacy. While Polderman suggests that a combination spray is efficacious (Polderman 2009), there is little published evidence to support its use. Moreover, alcohol can be drying to skin, and alcohol toxicity has been reported with the use of 100% isopropyl or ethyl alcohol for sponge baths in both children and older adults (Axelrod 2000). There is a need for research to evaluate the use of the alcohol and water sprays in fever

management. Several participants reported the use of an available 'loophole' for acetaminophen, administering it at lower temperatures than ordered for fever under its availability for pain, circumventing the system to keep fever down. This provides confirmation of findings from a previous study where 20% of acetaminophen doses were given at temperatures lower than was ordered for fever management purposes (Thompson *et al.* 2007b).

In another study by Edwards *et al.* (2007), there was an apparent lack of understanding of the underlying pathophysiology of fever. This knowledge gap is also apparent in our findings as the majority of nurse participants could not distinguish hyperthermia from fever. Nurses should understand that fever plays a larger role in the outcome of neurological injury to make evidenced-based clinical decisions in managing these patients. Our results suggest that additional education is needed with regard to thermoregulation and the pathophysiology of fever, best practices for fever management and culture protocols and the implications of fever in different patient populations. Previous work has reported that a peer education programme can be an effective means of conveying information to nurses with regard to fever management in paediatric patients (Edwards *et al.* 2007). This method could be adapted to improve knowledge and EBP for patients with neurological disorders or injury. Of particular importance in the present study, nurses working in dedicated neuroscience units expressed that febrile patients needed to be treated differently and their assessment approach differed significantly from that of nurses working on mixed units. This further supports the value of specialty knowledge on dedicated nursing units, which should be considered by clinical administration.

Study limitations

The use of two academic medical centres may be viewed as a potential limitation of this study as nursing practices often vary widely based on type of practice setting (e.g. Lee *et al.* 1997); however, the two institutions serve very different purposes and populations. The descriptive credibility and relevance of the present findings to countries outside the US need to be confirmed.

Conclusions

These findings suggest opportunities to educate nurse to improve patient care, as there was a lack of understanding of temperature regulation and fever. While nurses reported doing 'what worked', this may not have always been based on best practice.

Nurses chose fever intervention strategies that worked in part because there was a lack of collaboration with nursing in development of the institutional fever management protocol. This lack of interdisciplinary involvement in the development of patient care protocols probably served to create a barrier to their use.

Implications for research

Further research in other countries is needed to extend this work as nursing practices are often subject to regional trends. This work focused on nurses working with one vulnerable population: those with neurological insults. It would therefore be important to extend this work to other vulnerable populations such as those with cancer or burns to determine if similar issues arise and should be addressed.

Implications for nursing practice

Nurses need to understand fully the temperature regulation and febrile response to provide best practice. Due to the negative effects of fever in persons with neurological insult, nurses

caring for these patients need to be vigilant in monitoring temperature and assessing for other signs and symptoms. Furthermore, the medical record frequently lacks detail with regard to individualized assessment of these signs and symptoms and successful management strategies. Nurses need to be more explicit in their documentation to assist future caregivers; this explicit documentation could improve the recognition and treatment of fever. To promote this, electronic or paper medical records could integrate documentation prompts or tools.

Implications for nursing policy

As fever management is a collaborative enterprise, we recommend that protocols be developed with all team members represented to foster local adaptation of best practices. This may also further application of best practices by encouraging individual nurses to think of institutional protocols not as a recipe, but rather as a guide to care of the individual patient. Nurses working on neuroscience specialty care units articulated clear differences in the management of patients with neurological disorders or injury with fever compared with those working on mixed units. This finding endorses the value of specialty knowledge in narrowing the translational gap and offers institutions further evidence for planning and structuring the organization of care.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

This paper is dedicated to the memory of Deborah Webb, MSN, without whose assistance this study could not have been completed.

Funding

This work was supported in part by grants from the Integra Foundation/Neuroscience Nurses Foundation, the National Institutes of Health (T32NR007106; 1KL2RR025015) and the John A. Hartford Foundation Building Geriatric Academic Nursing Capacity Program (06-202).

References

- Adams HP Jr, del Zoppo G, Alberts MJ, Bhatt DL, Brass L, Furlan A, Grubb RL, Higashida RT, Jauch EC, Kidwell C, Lyden PD, Morgenstern LB, Qureshi AI, Rosenwasser RH, Scott PA, Wijdicks EF. Guidelines for the early management of adults with ischemic stroke: a guideline from the American Heart Association/American Stroke Association Stroke Council, Clinical Cardiology Council, Cardiovascular Radiology and Intervention Council, and the Atherosclerotic Peripheral Vascular Disease and Quality of Care Outcomes in Research Interdisciplinary Working Groups: The American Academy of Neurology affirms the value of this guideline as an educational tool for neurologists. *Circulation* 2007;115(20):e478–e534. [PubMed: 17515473]
- Adelson PD, Bratton SL, Carney NA, Chesnut RM, du Coudray HE, Goldstein B, Kochanek PM, Miller HC, Partington MD, Selden NR, Warden CR, Wright DW. Guidelines for the acute medical management of severe traumatic brain injury in infants, children, and adolescents. Chapter 14. The role of temperature control following severe pediatric traumatic brain injury. *Pediatric Critical Care Medicine* 2003;4(3 Suppl):S53–S55. [PubMed: 12847350]
- Albrecht RF II, Wass CT, Lanier WL. Occurrence of potentially detrimental temperature alterations in hospitalized patients at risk for brain injury. *Mayo Clinic Proceedings* 1998;73(7):629–635. [PubMed: 9663190]
- Alexander, SE.; Gallek, M.; Presciutti, M.; Zrelak, P. SAH guideline. In: Thompson, HJ., editor. *Care of the Patient with Aneurysmal Subarachnoid Hemorrhage*. American Association of Neuroscience Nurses; Glenview, IL: 2007.

- Axelrod P. External cooling in the management of fever. *Clinical Infectious Diseases* 2000;31(Suppl. 5):S224–S229. [PubMed: 11113027]
- Brain Trauma Foundation/American Association of Neurological Surgeons . Guidelines for the management of severe traumatic brain injury. *Journal of Neurotrauma* 2007;24(Suppl. 1):S1–S106.
- Bruderlein U, Strupp P, Vagts DA. Fever in intensive care patients. *Anesthesiologie, Intensivmedizin, Notfallmedizin, Schmerztherapie* 2006;41(7–8):E8–E18.
- Cairns CJ, Andrews PJ. Management of hyperthermia in traumatic brain injury. *Current Opinion in Critical Care* 2002;8(2):106–110. [PubMed: 12386509]
- Childs C, Vail A, Protheroe R, King AT, Dark PM. Differences between brain and rectal temperatures during routine critical care of patients with severe traumatic brain injury. *Anaesthesia* 2005;60(8):759–765. [PubMed: 16029224]
- Cooper, KE. *Fever and Antipyresis: The Role of the Nervous System*. Cambridge University Press; Cambridge: 1995.
- Cooper KE. Some historical perspectives on thermoregulation. *Journal of Applied Physiology* 2002;92(4):1717–1724. [PubMed: 11896042]
- Diringer MN, Reaven NL, Funk SE, Uman GC. Elevated body temperature independently contributes to increased length of stay in neurologic intensive care unit patients. *Critical Care Medicine* 2004;32(7):1489–1495. [PubMed: 15241093]
- Edwards HE, Courtney MD, Wilson JE, Monaghan SJ, Walsh AM. Fever management practises: what pediatric nurses say. *Nursing & Health Sciences* 2001;3(3):119–130. [PubMed: 11882188]
- 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):257–269. [PubMed: 17233646]
- Emmott U, Mansson ME. Nursing care in fever – a literature study and intensive care nurses' viewpoint on nursing care and treatment of fever. *Vard Nord Utveckl Forsk* 1997;17(4):4–8. [PubMed: 9464152]
- Greer DM, Funk SE, Reaven NL, Ouzounelli M, Uman GC. Impact of fever on outcome in patients with stroke and neurologic injury: a comprehensive meta-analysis. *Stroke* 2008;39(11):3029–3035. [PubMed: 18723420]
- Grossman D, Keen MF, Singer M, Asher M. Current nursing practices in fever management. *Medsurg Nursing* 1995;4(3):193–198. [PubMed: 7780472]
- Guba EG. Criteria for establishing the trustworthiness of naturalistic inquiries. *Educational Communication and Technology Journal* 1981;29:75–91.
- Hajat C, Hajat S, Sharma P. Effects of poststroke pyrexia on stroke outcome: a meta-analysis of studies in patients. *Stroke* 2000;31(2):410–414. [PubMed: 10657414]
- High KP, Bradley SF, Gravenstein S, Mehr DR, Quagliarello VJ, Richards C, Yoshikawa TT. Clinical practice guideline for the evaluation of fever and infection in older adult residents of long-term care facilities: 2008 update by the Infectious Diseases Society of America. *Journal of the American Geriatrics Society* 2009;57(3):375–394. [PubMed: 19278394]
- Jiang JY, Gao GY, Li WP, Yu MK, Zhu C. Early indicators of prognosis in 846 cases of severe traumatic brain injury. *Journal of Neurotrauma* 2002;19(7):869–874. [PubMed: 12184856]
- Johnston NJ, King AT, Protheroe R, Childs C. Body temperature management after severe traumatic brain injury: methods and protocols used in the United Kingdom and Ireland. *Resuscitation* 2006;70(2):254–262. [PubMed: 16828961]
- Kilpatrick MM, Lowry DW, Firlik AD, Yonas H, Marion DW. Hyperthermia in the neurosurgical intensive care unit. *Neurosurgery* 2000;47(4):850–855. discussion 855–856. [PubMed: 11014424]
- Kirkness CJ, Burr RL, Thompson HJ, Mitchell PH. Temperature rhythm in aneurysmal subarachnoid hemorrhage. *Neurocritical Care* 2008;8(3):380–390. [PubMed: 18066502]
- Laupland KB. Fever in the critically ill medical patient. *Critical Care Medicine* 2009;37(7 Suppl):S273–S278. [PubMed: 19535958]
- Lee AJ, Huber JH, Stason WB. Factors contributing to practice variation in post-stroke rehabilitation. *Health Services Research* 1997;32(2):197–221. discussion 223–227. [PubMed: 9180616]

- McIlvoy L. The impact of brain temperature and core temperature on intracranial pressure and cerebral perfusion pressure. *Journal of Neuroscience Nursing* 2007;39(6):324–331. [PubMed: 18186416]
- Miles, MB.; Huberman, AM. *Qualitative Data Analysis: An Expanded Sourcebook*. Sage; Thousand Oaks, CA: 1994. Making good sense: drawing and verifying conclusions; p. 245–287.
- Natale JE, Joseph JG, Helfaer MA, Shaffner DH. Early hyperthermia after traumatic brain injury in children: risk factors, influence on length of stay, and effect on short-term neurologic status. *Critical Care Medicine* 2000;28(7):2608–2615. [PubMed: 10921603]
- Oeyen S. Closing the gap between knowledge and behavior: mission impossible? *Critical Care Medicine* 2007;35(9):2219–2220. [PubMed: 17713374]
- O'Grady NP, Barie PS, Bartlett JG, Bleck T, Carroll K, Kalil AC, Linden P, Maki DG, Nierman D, Pasculle W, Masur H. Guidelines for evaluation of new fever in critically ill adult patients: 2008 update from the American College of Critical Care Medicine and the Infectious Diseases Society of America. *Critical Care Medicine* 2008;36(4):1330–1349. [PubMed: 18379262]
- Polderman KH. Mechanisms of action, physiological effects, and complications of hypothermia. *Critical Care Medicine* 2009;37(7 Suppl):S186–S202. [PubMed: 19535947]
- Reaven NL, Lovett JE, Funk SE. Brain injury and fever: hospital length of stay and cost outcomes. *Journal of Intensive Care Medicine* 2009;24(2):131–139. [PubMed: 19188268]
- Rosenberg JP, Yates PM. Schematic representation of case study research designs. *Journal of Advanced Nursing* 2007;60(4):447–452. [PubMed: 17822427]
- Schulman CI, Namias N, Doherty J, Manning RJ, Li P, Alhaddad A, Lasko D, Amortegui J, Dy CJ, Dlugasch L, Baracco G, Cohn SM. The effect of antipyretic therapy upon outcomes in critically ill patients: a randomized, prospective study. *Surgical Infections (Larchmt)* 2005;6(4):369–375.
- Segatore M. Fever after traumatic brain injury. *Journal of Neuroscience Nursing* 1992;24(2):104–109. [PubMed: 1602170]
- Sinuff T, Cook D, Giacomini M, Heyland D, Dodek P. Facilitating clinician adherence to guidelines in the intensive care unit: a multicenter, qualitative study. *Critical Care Medicine* 2007;35(9):2083–2089. [PubMed: 17855822]
- Stocchetti N, Rossi S, Zanier ER, Colombo A, Beretta L, Citerio G. Pyrexia in head-injured patients admitted to intensive care. *Intensive Care Medicine* 2002;28(11):1555–1562. [PubMed: 12415441]
- Thompson HJ, Tkacs NC, Saatman KE, Raghupathi R, McIntosh TK. Hyperthermia following traumatic brain injury: a critical evaluation. *Neurobiology of Disease* 2003;12(3):163–173. [PubMed: 12742737]
- Thompson HJ, Kirkness CJ, Mitchell PH. Fever management practices of neuroscience nurses, part II: nurse, patient, and barriers. *Journal of Neuroscience Nursing* 2007a;39(4):196–201. [PubMed: 17847665]
- Thompson HJ, Kirkness CJ, Mitchell PH. Intensive care unit management of fever following traumatic brain injury. *Intensive and Critical Care Nursing* 2007b;23(2):91–96. [PubMed: 17223560]
- 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):453–464. [PubMed: 15713177]
- Wartenberg KE, Schmidt JM, Claassen J, Temes RE, Frontera JA, Ostapovich N, Parra A, Connolly ES, Mayer SA. Impact of medical complications on outcome after subarachnoid hemorrhage. *Critical Care Medicine* 2006;34(3):617–623. quiz 624. [PubMed: 16521258]
- World Health Organization. *Global Burden of Disease-2004 Update*. WHO; Geneva, Switzerland: 2008.
- Yin, RK. *Case Study Research: Design and Methods*. Sage; Newbury Park, CA: 2003.

Table 1

Meta-matrix of identified themes and supporting evidence

Assessment/analysis	Theme	Factors that enhance best practice	Factors that inhibit best practice	Differences seen with specialty care
Assessment/analysis	Defining fever	'I think a fever is a good thing...you know...your body trying to getting rid of whatever in the body that is shouldn't be there'	'It's kind of just a general 38.5 and I would say most people will just have it on the back of their heads they don't look at individual It's very arbitrary number so I think it is kind of a loose thing that we don't look at very closely'	'Temp greater than whatever's normal for the patient'
	Fever vs. Hyperthermia	'hyperthermia is totally different than fever... Hyperthermia can be fever or can be like your expose to too much heat'	'I think of it as the same'	'fever I think of more infectious... hyperthermia I think of either a matter of brain syndromes, you know traumatic brain injury'
	Patient assessment	'So, I look at my patient, and I say to myself: does what the reading I am getting match with what I am seeing with them? Do they look really sick? Are they acting really sick that they have a fever...have I noticed any changes?'	'Is the thermometer malfunctioning?' Is it the 6th patient in a row with the same temperature] which happens with the tympanics – I will then switch out the thermometer that is malfunctioning'	'sometimes people's neuro[logical] changes happen when they have their fevers' '[The protocol states] tympanic. Brain isn't on there. We do it [treat fever] to improve their brain outcome, shouldn't we be worried about the brain temperature?'
Planning/implementation	Rationale for choice of intervention	'It's nursing discretion' 'Sometimes I just turn on fan in the room, taking a few blankets off... take some deep breaths, loosen up clothing...you know if they can drink something give them a little something to drink...do what I call 'the mom things'...what I have done at home with my kids you know...try something first of all...it may be obvious'	'Every nurse is basically just doing their own sort of things with no guideline other than if the doctor wrote Tylenol at a certain temperature' 'I follow the protocol'	'I'm looking at what's going on, are they just getting] out of surgery? I have a patient today who just had a surgery yesterday ...so he got this fever ...and I was just now giving him some Tylenol and since he is not breathing deeply... I try to get him breathe more and that kind of thing. We have to look at each individual case and see what going on with it'
	Pharmacological interventions	'if they have Tylenol ordered I like doing that' 'you usually go through your usual bag of tricks, when the Tylenol is not working- usually do q 4 Tylenol, then Ibuprofen'	'Sometimes if I know that they regularly raise up a little to 37.9 it might be just in mild pain and I will ask them if they want Tylenol just to keep fever down'	'A lot of time with neuro patients Tylenol doesn't do any good and so you have to use other things are like cooling blanket, ice packs, whatever, turn the room temperature down, put the fan on that kind of stuff'
	Non-pharmacologic interventions	'I will try and work with the environment before I start doing on-slaught with the medications, so..if I drop the room temperature and check it again in an hour and dropped then obviously the environmental causes. If it hasn't drop in that hour then look at [other interventions]'	'I put ice to the groin to bring the temperature down; I don't like fans because they spread the bugs' 'In the old days we used to [put] alcohol in the water, but can't do that anymore.... (later off tape) I still use alcohol though' had the fan on and window open'	'sometimes I think that brain injury, blood in the head, the brain, whatever or TBI and they have fever for that reason as oppose to somebody who has pneumonia uhm... so I might skip the first couple things and I will go straight to the bath, and then right to ice packs on the head you know...because I know they are a little difficult to bring down fever...so..it's not just okay ... but if I know it is neuro temp...then I won't hesitate as much with the cooling

Theme	Factors that enhance best practice	Factors that inhibit best practice	Differences seen with specialty care
Effect of physician	'because of the physician-driven protocol they are a little more strict it seems than other patients, you're like oh they have a fever' and they're like 'let's do this and let's do this', but its more active it seems with the neuro patients'	'Physician response time is sometimes a barrier. And on nights, sometimes they want to hold off on doing anything-that can be a barrier'	blankets because I know that sometimes it's the only thing that works' 'The physicians are active in keeping their temperature lower. They don't want them to have fever... they are cooling neuro patients earlier'
Effect of protocol	'Dr M' _____s been very involved in getting out the protocol, and trying to get them more organized'	'the only thing is that the protocol that they have now I think that they are a little aggressive'	
Total body/pan cultures	'There has been a lot of debate about the cultures...if it has been really necessary, because that is very tedious. I mean those patients are getting poked every day... why are we wasting money? We're wasting the lab's time and our time'	'the resident wrote for blood culture and the urine again. And I called them on it and I said ...Are we really addressing the issue by getting another set of blood cultures at this point?'	'I'm not a big fan of the total cultures, I would totally do something to cool them down if I saw their brain temp is 38.5 but I don't know if I would necessarily culture them yet because that probably have more to do with their brain injury than actual infection in the body depending on what their CSF numbers look like'
Efficacy	'[look at] other vital signs, how comfortable they are, if they are shivering...if they're sweating... indications that the fever is coming down'	'If [fever] is stubborn and not coming down, last resort is usually a cooling blanket'	
Patient difference in response	'fevers in kids are treated differently than adults, you know they can tolerate higher numbers so you are not going to necessarily be as aggressive unless they are a head injury kid'	'sometimes when I take care of a patient sometimes they are very good...they do everything, but still the temperature won't come down for two or three days... we look at all kind of things, sometimes we check it, change it to a different thing... and we do all kind of tests to find exact cause, [but] everything [is] negative-hard to manage that kind of situation'	'the neuro temp, it's the only one that's been the most puzzling. It is hard to break and is hard to bring it down'
Barriers to treatment	'I can't say I've run across a lot of barriers'	'A couple of times I had patients with fever and there was only one [specific device] in house, and a cooling blanket can be hard to get because they only have so many'	