Monitoring temperature

by Matthew Robertson and Barry Hill

ABSTRACT:

This article explains the importance of temperature monitoring observations and highlights that the procedure is a fundamental aspect of nursing care. It discusses the physiology of temperature regulation, introduces different types of temperature monitoring devices and provides a step-by-step guide on how to take a temperature using a tympanic thermometer. It emphasises the importance of evidence-based practice to underpin temperature monitoring, as well as conditions that it is important for nurses to consider when recording patients' temperatures.

Key words: Temperature ■ Monitoring ■ Hypothermia ■ Thermometer

Temperature is defined as 'the degree of internal heat of the body' (White et al, 2011). Temperature monitoring is a fundamental nursing skill and, when assessing a patient's temperature, it is important to place the numerical value of the reading in the context of the patient's presenting condition and symptoms. Why measure temperature? A patient's temperature should always be recorded when conducting vital signs monitoring checks (Bickley, 2016). The assessment of temperature as an initial clinical examination allows practitioners to gain a greater insight into the patient's current condition, so that more appropriate treatment and care can be given. Temperature monitoring should also be used to measure the effectiveness of, and track the side effects arising from, any intervention delivered to the patient (Bickley, 2016), such as taking a temperature preoperatively to monitor the effects of an anaesthetic. Several factors can affect temperature, such as presenting clinical conditions, infections, brain function and injury, cardiac function including hypotension, bleeding and haemorrhage, age, body mass and the environment.

The physiology of temperature regulation

The hypothalamus is the brain's heat regulatory system, which manages behaviour and physiology to combat these methods of heat loss or gain (Rosdahl and Kowalski, 2016). Heat is generated by the basal metabolic system, through the consumption of food and by muscle contraction such as shivering, voluntary activity and behaviours. An example of a behavioural action to react to changes in environmental temperature would be to put on another layer of clothing when cold (Campbell, 2011). Heat is conserved by vasoconstriction of the peripheral blood vessels. The methods by which the hypothalamus controls our behaviour and physiology are usually effective at regulating our body temperature. According to Woodhead and Fudge (2012), patients may experience heat loss via four methods: evaporation, convection, conduction and radiation. These methods can often be used in a therapeutic sense when caring for a patient.

Evaporation

During evaporation the hypothalamus signals to the sweat glands all over the body to release sweat through ducts on the surface of the skin. When the sweat evaporates, this causes heat loss.

Convection

Convection is heat loss via air movement. For example, the use of a fan to cool a patient down is promoting heat loss through convection. This method is more effective if the skin is slightly moist.

Conduction

If a patient who had hyperthermia were to use an ice pack or a cold flannel to chill themselves, they would be promoting heat loss through conduction. Heat will always travel from hot to cold because the particles that have the higher temperature are more active.

Radiation

Finally, heat loss through radiation occurs when there is a transfer of heat from the surface of one object to the surface of another without contact being made. For example, a patient without a blanket is going to radiate more heat than a patient who is covered. Also, a patient who is standing up will radiate more heat than someone lying in the fetal position (Potter et al, 2017).

Temperature changes

When body temperature is in the normal range (Box 1), body tissue and cells still work efficiently and effectively (Potter et al, 2017). When a patient's temperature starts to rise or fall, this can cause serious physiological issues, but it can also be a key indicator for diagnosis. Prolonged hypothermia causes vasoconstriction and bradycardia is a heat-preservation mechanism. Such changes will affect the delivery of energy and oxygen to cells (Dutton and Finch, 2018) and will result in slowed breathing, lack of co-ordination, irritability, confusion and sleepy behaviour.

Hyperthermia, or pyrexia, is often described as having a prolonged core temperature of above 38°C (Williams and Hopper, 2015). The consequences of pyrexia are vasodilation and an initial hypotension, as the body attempts to release the heat through radiation. The heart will usually become tachycardic to compensate for the circulating volume trying to maintain the delivery of oxygen and energy to cells. This is a compensatory mechanism, known as cardiac compensation, to promote blood flow and oxygen delivery to cells to prevent cell death and organ failure. The volumes of blood and urine are reduced due to loss of water through increased perspiration (Dutton and Finch, 2018). Body protein is rapidly broken down, leading to increased excretion of nitrogenous products in the urine. When the body temperature rises rapidly, the affected person may feel cold due to the evaporation occurring on the surface of their skin. When taking a patient's temperature, it is important to consider several factors, such as the appropriate choice of thermometer (Box 2 and Table 1) (Perry et al, 2014). Digital thermometers are an accurate and easy way to take a temperature from the armpit or mouth, so with children aged under 5 years they are suitable to measure temperature under their armpit. Tympanic (ear) thermometers are quick and easy to use, but they will be initially expensive. However, the single patient probe covers make them cost effective when they are used correctly. If the thermometer is not correctly placed in the ear canal, the reading may not be accurate, so correct placement is important (Levin et al, 2016). New evidence has shown that strip-type thermometers are not an accurate method for taking a temperature. This is because they measure the temperature on the skin's surface, rather than the body's core temperature. Mercury-inglass thermometers are no longer sold and should not be used: this is because they can break, releasing small shards of glass and highly poisonous mercury. Gates et al (2018) has emphasised that care should be taken in the choice of thermometer with some critically ill patients because core temperature is not always accurately recorded by non-invasive methods (Table 1).

Considerations when measuring temperature via the tympanic membrane

Potter et al (2017) suggested that taking temperature via the tympanic membrane is the most easily accessible method to monitor a patient's core temperature. It maintains the dignity of the patient and is a relatively non-invasive, pain-free method to take a temperature. If done correctly, the process of taking a temperature should take only 2–5 seconds. The tympanic membrane is sensitive to core temperature changes, which allows for an accurate reading. However, it does not provide a continuous measurement and readings may often be distorted if the ear has a build-up of cerumen (earwax). In addition, it is not appropriate for use with small children because their ear canal is too small to accommodate the device. An alternative is monitoring temperature via the skin: this uses a wearable thermometer that adheres to the skin and continuously monitors the patient's temperature. However, it should be borne in mind that this thermometer type is less sensitive to core body temperature changes and readings can be distorted by diaphoresis (sweat) (Campbell, 2011).

Box 1. Temperature values ■ Hypothermia 38.0°C ■ Normal range in accordance with definitions: 35.1°−37.9°C ■ Optimal range for homeostasis: 36.5°−37.5°C Source: White et al, 2011

Box 2. Types of temperature measurement There are six ways to take a core temperature: ■ Tympanic ■ Nasopharyngeal ■ Oesophageal ■ Rectal ■ Axillary ■ Sublingual. All have their advantages and disadvantages, and all will record slightly different values Source: Campbell, 2011; Gates et al, 2018

How to take a temperature via the tympanic membrane: a step-by-step guide

Procedure and equipment needed (Campbell, 2011):

■ Ensure that you introduce yourself to your patient ■ Explain what you are doing and gain consent for the procedure ■ Wash or gel hands, as appropriate, in accordance with the 5 moments for hand hygiene (World Health Organization, 2019) and the employer's infection prevention and control policy ■ Attach a clean probe tip to the thermometer, then listen for the audible click to ensure it is securely in place ■ Gently pull on the patient's ear to gain access to the ear canal, place the thermometer in the ear canal so there is a light seal around the probe cover. Press the button on the thermometer for one second. Remove the thermometer from the patient's ear canal and take the reading ■ If the reading is out of the normal range, ensure you have inserted the probe in far enough to detect the heat. Alternatively, try the other ear to compare your findings ■ Once you have finished, reveal the result to the patient, document your findings accurately and wash/gel your hands and disinfect any equipment that is not disposable.

Surgical patients

The National Institute for Health and Care Excellence (NICE) (2016) has produced a guideline on the most effective ways to prevent, manage and treat hypothermia in surgical patients, who tend to be at greater risk than medical patients. The guideline states that any practitioner using temperature monitoring equipment, or any warming and cooling equipment, should undergo training and be competent in its use. Forced air warmers are common in the perioperative environment today and have the capability to both warm and cool surgical patients. Okoué et al (2018) suggest that forced air warmers are the most effective method for reducing the risk of perioperative hypothermia. Appropriate training should be offered on the use of these devices if required (NICE, 2016). NICE (2016) also states that practitioners should be aware that keeping patients warm before surgery decreases the risk of any postoperative complications such as haemorrhage, surgical-site infection and delayed wound healing (Hart et al, 2011).

Table 1. Pros and cons of non-invasive methods for measurement of body temperature			
Site of measurement	**Technical design**	**Pros**	**Cons**
Ear	■ Infrared radiation device ■ Measures the infrared heatwaves from the tympanic membrane	■ Assesses core temperature ■ Close to hypothalamus ■ Hygienic ■ Rapid measurement ■ Convenient for the patient ■ Painless for the patient ■ Does not threaten the patient's integrity	■ Gives low readings if incorrectly placed ■ Training in operator technique is needed before performance ■ The reading may be influenced by otitis ■ Incorrect placement of the probe due to a narrow cavity may affect accuracy
Rectal	■ Digital electronic device ■ A sensor produces electronic signals, reflecting the tissue temperature ■ Temperature displayed in unadjusted, adjusted value in a steady-state mode or a predictive mode	■ Assesses core temperature ■ Easy to perform	■ The reading is higher than at other places during steady state ■ Affected by hard stool and heat-producing activity of micro-organisms in faeces ■ Affected by inflammation around the rectum ■ The thermometer has to be inserted 4 cm in adults and 2–3 cm in a child, to give a correct reading ■ Serious lag time for adjustment to set point temperature, especially during rapid changes, such as cooling of the skin, exercise, fever and hypothermia ■ Risk of nosocomial infection ■ Risk of rupture of intestinal mucosa ■ Embarrassing for the patient ■ Intrusive for the patient
Oral	■ Digital electronic device ■ A sensor produces electronic signals, reflecting the tissue temperature ■ Temperature displayed in unadjusted, adjusted value or a predictive mode	■ Assesses core temperature ■ Easy to perform	■ Placement affects the reading, eg there is a difference between the posterior pocket and the front area, and also between the posterior pockets ■ Affected by salivation, previous intake of hot or cold food and fluids, smoking, gum chewing, and breathing with open mouth ■ Contraindicated in unconsciousness, confused patients ■ Contraindicated when there is a risk of seizures ■ Inappropriate in individuals with unco-operative or disturbed behaviour ■ Inappropriate in young children
Axillary	■ Digital electronic device ■ A sensor produces electronic signals, reflecting the tissue temperature ■ Temperature displayed in unadjusted, adjusted or a predictive mode	■ Convenient for the patient ■ Might be reliable when measuring body temperature in babies under the age of 3 months	■ Does not assess core temperature ■ Strongly affected by ambient temperature, local blood flow, underarm sweat, appropriate placing of the probe or closure of the axillary cavity, and duration of the reading ■ The reading is lower compared with other sites in steady state ■ Serious lag time for adjustment to set point temperature, especially during rapid changes, such as cooling of the skin, exercise, fever and hypothermia ■ Unreliable for assessing body temperature
Temporal artery (forehead)	■ Infrared radiation device ■ Measures the infrared heatwaves from the skin above the tympanic artery	■ Convenient for the patient ■ Might be reliable when measuring body temperature in babies under the age of 3 months	■ Does not assess core temperature ■ Unreliable for assessing body temperature ■ Strongly affected by local blood flow, placement of the device, moisture in the skin, the amount of subcutaneous fat, physical activity and ambient temperature ■ The reading is lower compared with other sites in steady state ■ Serious lag time for adjustment to set point temperature, especially during rapid changes, such as cooling of the skin, exercise, fever and hypothermia

Source: Sund-Levander and Grodzinsky, 2009; 2013

Sepsis

Although the focus of this article is to explore temperature monitoring, it is imperative that sepsis is considered when performing any patient assessment or activity. The NICE (2017) guideline, Sepsis: Recognition, Diagnosis and Early Management, specifies that clinicians must 'assess temperature, heart rate, respiratory rate, blood pressure, level of consciousness and oxygen saturation in young people and adults with suspected sepsis' when undertaking a face-to-face assessment of patients with suspected sepsis. A raised temperature is recognised as a key indicator in diagnosing sepsis, and ongoing temperature monitoring will indicate the progression of the infection (Mai et al, 2018).

Conclusion

Temperature monitoring is a fundamental skill used by nurses in clinical practice. It is a vital sign that is significant and must be acknowledged as such. Using the right equipment and the correct route of measurement, ie the ear (tympanic thermometer), is important for obtaining an accurate reading. Ensure that the patient has given consent for the procedure, that infection control policy has been followed, and the relevant documentation is accurate and legible. Escalate any concerns you may have, and always advocate for your patient.

LEARNING OUTCOMES

■ Understand the importance of temperature monitoring observations ■ Give rationale to the importance of temperature monitoring as a clinical skill ■ Understand the physiology of temperature regulation ■ Be aware of the different types of temperature monitoring device and how to record a temperature using a tympanic thermometer

CPD reflective questions

■ What temperature equipment do you use in your clinical setting? Why do you use this method and can you rationalise why this is the best option? ■ What route do you use to measure temperature? Think about the evidence presented in this article: is an evidencebased approach used in your practice? ■ Do you nurse surgical or septic patients? What would you do differently after reading this article?

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