

Understanding Fever Screening and Methods

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Recent pandemics have created the need for fever screening. Picking a method is not an easy task. Core temperature measurement is widely misunderstood by mainstream professionals.

Before we can understand fever and measurement we first need to understand what core temperature is and the importance.

Core temperature is the operating temperature of the human body that allows the organs and systems of the body to carry out their function. Core temperature is responsible for maintaining homeostasis within the organism allowing chemical reactions to take place within a degree of accuracy. In a state of hypothermia or hyperthermia the organism ceases to function properly and life can not be maintained. Core temperature is regulated by the biological thermostat in the brain called the Hypothalamus.

It was Carl Wunderlich In the 19th Century who established that the body's core temperature to be 37C (98.6 F) This measurement was taken with large cumbersome thermometers of the time in the axilla. Current thermometers are smaller and much more accurate than during his time. Several more recent studies have been performed and show this number to be lower or higher. The data suggests a dynamic temperature range to be normal depending on the time of day or activity levels. For the purpose of screening today most use the cut off of 100.4 as the threshold for fever.

Various methods have been used to assess core temperature including the oral measurement, rectal measurement, axilla measurement, tympanic measurement, and skin surface temperatures.

The most accurate of these and closest to actual core temperature is the rectal measurement. This is the gold standard; however it is socially awkward and impractical to screen patients with this method so we have sought other methods that are less accurate, but more practical and time efficient.

The oral temperature measurement has been used for many years and is a mostly reliable measurement. The temperature measurement is about one-half of a degree less than the rectal method. It takes 5 to 15 minutes to equilibrate to receive an accurate measurement making this test also impractical for screening.

Tympanic measurement is taken by infrared sensors of the tympanic membrane. The sensor converts the infrared data into a temperature measurement through calibration, and is reasonably accurate as an instrument when compared to a black body with a constant

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temperature. However, according to Dodd, et al, "In a systematic review, infrared ear thermometry for fever diagnosis in children finds poor sensitivity." This may be due to the tortuous nature of the external auditory meatus. This ear canal becomes more tortuous as we become adults and the accuracy of measurement is reduced.

Axillary temperatures are usually less than oral and rectal measurements. The expected measurement difference is about 1 to 2 degrees lower than rectal measurements making this method an unreliable method for accuracy. The time it takes to perform the test is similar to the oral method.

Infrared skin surface temperature measurements of the face (ISO 13154-2017) have been used in screening large populations and are becoming more common in ports of entry, factories, and other public venues. The skin surface temperature measurements should only be performed by specialized medical devices that carry FDA clearance. The temperature measurements can be obtained accurately within seconds making it practical for screening large groups efficiently.

The question becomes how does the skin surface temperature compare to the core temperature? The data is growing for this numerical value however as with other methods it becomes dependent on environmental factors. For example the oral temperature can be altered by hot or cold drinks, or other factors that may affect accurate measurement. With infrared fever assessment we are using the inner canthus of the eye that correlates the closest with core temperature as it is innervated by the carotid artery. This temperature measurement may be altered slightly by environmental factors including weather, air currents, and extraneous electromagnetic radiation.

There can not be an accurate and definitive correlation from skin surface temperature measurements to core body temperature as homeostasis is continuously changing to create a favorable environment for reactions to take place in the core. It is similar to the thermostat in a home that when set takes time to bring the house temperature to equilibrium.

Infrared thermal screening of patients is performed as a primary screening method whereby secondary methods are used to assess more accurately. Low alarm thresholds are used for skin surface temperature measurements when screening the public. Not all positive screenings will be actual patients with fevers. There will be a degree of false positives. This is similar to a metal detector at an airport, as sensitivity is set high to trigger alarms for secondary screening.

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Based on this article the most accurate method to test patients would be to perform anal measurements on every subject. Due to obvious impracticalities we have established that the fastest and safest method is screening through infrared methods.