

# Best practices in thermometry:



## Temperature reading guidelines for clinical and at-home users

Temperature readings vary and are dependent on many factors including age and measurement site. An exact relationship between oral (mouth), rectal, tympanic (ear), axillary (armpit) and forehead doesn't exist. **Readings from different sites should not be compared.**

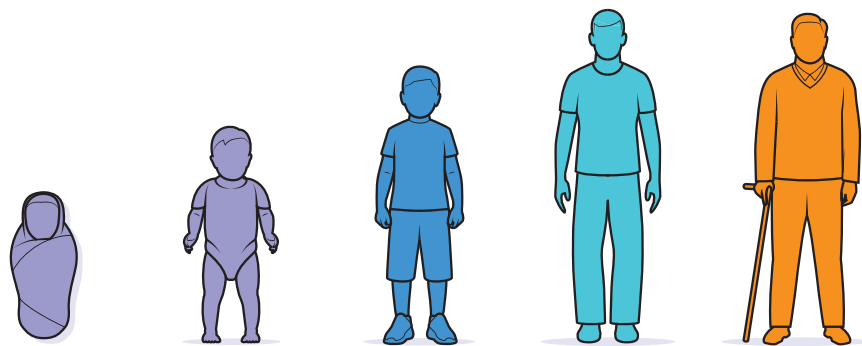
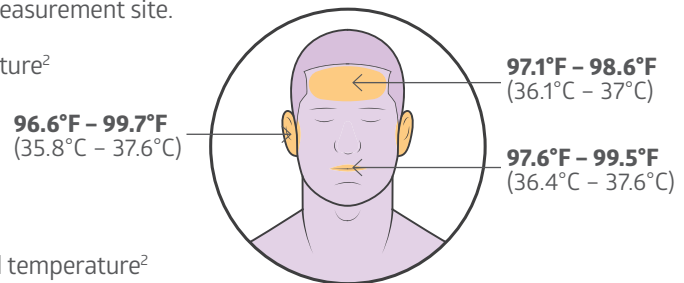
It's recommended that you choose one site for temperature measurement and become comfortable, consistent and familiar with the readings to understand your own baseline temperature.

The following document discusses certain variables that can affect temperature readings, as well as tips and considerations that may help overcome common roadblocks that arise when taking body temperature.

### Choosing the most appropriate measurement site

Temperature variation from warmest to coolest is found below.<sup>1</sup> Methods that get closer to the core (inside of the body) are more accurate. The use of the oral cavity below is only used as a reference, as it is not the most accurate temperature measurement site.

- **Rectal:** 0.5°F (0.3°C) to 1°F (0.6°C) higher than oral temperature<sup>2</sup>
- **Tympanic (inner ear):** 0.5°F (0.3°C) to 1°F (0.6°C) higher than oral temperature<sup>2</sup>
- **Oral (mouth)**
- **Axillary (armpit):** 0.5°F (0.3°C) to 1°F (0.6°C) lower than oral temperature<sup>2</sup>
- **Temporal (forehead):** 0.5°F (0.3°C) to 1°F (0.6°C) lower than oral temperature<sup>2</sup>



Birth – 3 months    4 months – 2 years    3 – 10 years    11 – 65 years    >65 years

	Birth – 3 months	4 months – 2 years	3 – 10 years	11 – 65 years	>65 years
<b>Most accurate (definitive)</b>	Rectal	Rectal	Rectal	Rectal	Rectal
<b>Easiest technique (screening)*</b>	1. Axillary 2. Temporal	1. Axillary 2. Temporal 3. Tympanic	1. Tympanic 2. Temporal 3. Axillary 4. Oral	1. Oral 2. Tympanic 3. Temporal 4. Axillary	1. Temporal 2. Oral 3. Axillary 4. Tympanic

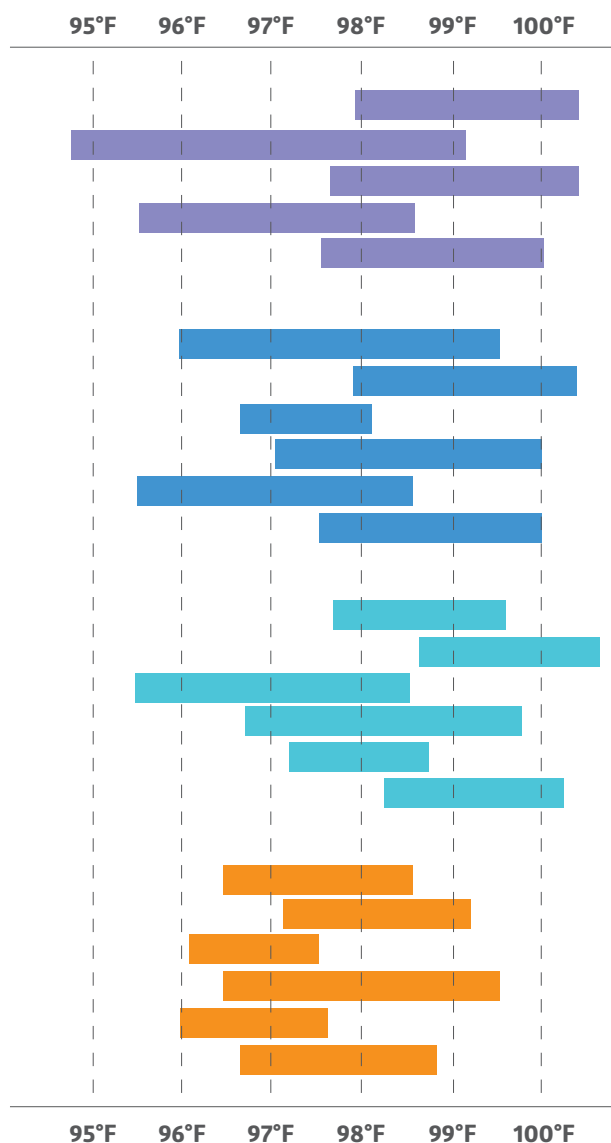
\*Easiest to least easy technique listed from 1-4

# Clinically acceptable temperature ranges

Table 1 below displays the normal body temperature ranges based on measurement site and age group. This table serves as a reference only. Data provided is compiled from multiple sources with varying levels of accuracy.<sup>1-3</sup>

**Table 1: Normal Body Temperature Ranges**

	<b>0 – 2 years</b>
<b>Oral (mouth)</b>	-
<b>Rectal</b>	97.9° – 100.4°F (36.6° – 38.0°C)
<b>Axillary (armpit)</b>	94.5° – 99.1°F (34.7° – 37.3°C)
<b>Tympanic (ear)</b>	97.5° – 100.4°F (36.3° – 38.0°C)
<b>Temporal (forehead)</b>	95.4° – 98.5°F (35.2° – 36.9°C)
<b>Core</b>	97.5° – 100.0°F (36.3° – 37.7°C)
	<b>3 – 10 years</b>
<b>Oral (mouth)</b>	95.9° – 99.5°F (35.5° – 37.5°C)
<b>Rectal</b>	97.9° – 100.4°F (36.6° – 38.0°C)
<b>Axillary (armpit)</b>	96.6° – 98.0°F (35.9° – 36.7°C)
<b>Tympanic (ear)</b>	97.0° – 100.0°F (36.1° – 37.7°C)
<b>Temporal (forehead)</b>	95.4° – 98.5°F (35.2° – 36.9°C)
<b>Core</b>	97.5° – 100.0°F (36.3° – 37.7°C)
	<b>11 – 65 years</b>
<b>Oral (mouth)</b>	97.6° – 99.5°F (36.4° – 37.6°C)
<b>Rectal</b>	98.6° – 100.6°F (37.0° – 38.1°C)
<b>Axillary (armpit)</b>	95.3° – 98.4°F (35.2° – 36.8°C)
<b>Tympanic (ear)</b>	96.6° – 99.7°F (35.8° – 37.6°C)
<b>Temporal (forehead)</b>	97.1° – 98.6°F (36.1° – 37.0°C)
<b>Core</b>	98.2° – 100.2°F (36.7° – 37.8°C)
	<b>&gt; 65 years</b>
<b>Oral (mouth)</b>	96.4° – 98.5°F (35.8° – 36.9°C)
<b>Rectal</b>	97.1° – 99.2°F (36.1° – 37.3°C)
<b>Axillary (armpit)</b>	96.0° – 97.4°F (35.5° – 36.3°C)
<b>Tympanic (ear)</b>	96.4° – 99.5°F (35.7° – 37.5°C)
<b>Temporal (forehead)</b>	95.9° – 97.5°F (35.5° – 37.5°C)
<b>Core</b>	96.6° – 98.8°F (35.8° – 37.1°C)



# Thermometers

When setting the stage for temperature readings, identify the type of thermometry that will be used and make sure that the equipment is ready, clean and additional accessories such as probe covers and sheaths are readily available. Check that the thermometer has been properly serviced and calibrated.

## Digital stick thermometer and sheaths

Use an approved sheath only  
MDS9607 oral; MDS9604 rectal (pre-lubricated)

Consists of a probe that is connected to electronic circuitry

- **Blue or white cap**—Oral or axillary use
- **Red cap**—Rectal use

Discard sheath after each use



30-second digital flexitip oral,  
axillary, rectal thermometer  
MDS99902



30-second rectal  
digital thermometer  
MDS9952



30-second oral digital  
stick thermometer  
MDS9950

## Oral (mouth) thermometry

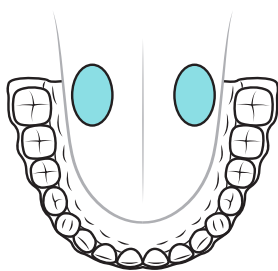
Confused or uncooperative patients, patients with a history of seizure, or individuals who have undergone any oral surgery/oral trauma are not candidates for oral thermometry.

### Taking oral temperature using the clinical digital thermometer (electronic contact thermometer)

- **Blue or white cap**—Oral or axillary use
- **Red cap**—Rectal use

#### Use of the probe at the wrong site will result in temperature errors

1. Remove the oral probe from the probe well.
2. Load appropriate probe cover.
3. Place the probe tip deep into the patients' sublingual pocket (displayed on the right, under the tongue, furthest back). Temperature differences in the oral cavity exist, highlighting the importance of inserting the probe in the correct area to achieve accurate temperature readings.
4. Hold the probe in place, keeping the tip of the probe in contact with the lining underneath the tongue near the rear of the sublingual pocket. Have the patient close their lips around the probe.
5. The unit will beep once a final measurement has been reached. Measurement duration should not exceed three minutes at the oral site.
6. Record the measurement site, which side of the mouth the measurement was taken, and properly dispose of the probe cover.



#### Oral temperature readings are affected by the following, wait at least 30 minutes before attempting measurement:

- Ingestion of hot or cold liquids
- Eating food
- Chewing gum or mints
- Brushing teeth
- Smoking
- Performing any strenuous activity

## Rectal thermometry

- Considered the reference standard, although there is a lag between changes in core body temperature and temperature in the rectum.<sup>4</sup>
- Do not take rectal temperature measurements in patients with neutropenia (presence of abnormally few neutrophils in the blood, leading to an increased susceptibility to infection).<sup>4</sup>

### Taking rectal temperature using a clinical digital thermometer (electronic contact thermometer)

Thorough hand washing greatly reduces the risk of cross contamination and infection.

Use appropriate probe cover to prevent inaccurate temperature readings: "Red for Rectal"

1. Remove the rectal probe from the probe well.
2. Lubricate the thermometer using a water-based lubricant or apply a pre-lubricated rectal sheath.
3. Lubricate the thermometer using a water based lubricant or apply a pre-lubricated rectal sheath (use of excessive lubricant may affect reading accuracy).
4. GENTLY insert the probe tip at least 2–3 cm ( $\frac{3}{4}$ "– $1\frac{1}{16}$ "") for adults and 1 cm ( $\frac{3}{8}$ ""), but not exceeding 1.5 cm ( $\frac{5}{8}$ "") for children, tilt the probe so that it's in contact with tissue and hold in place throughout the measurement process until audible beeps are heard (trained personnel recommended).
5. After the measurement is complete, remove the probe from the patient's rectum and eject into the probe cover.
6. Wash your hands.

## Axillary (armpit) thermometry

Direct skin contact is essential. This method is the most sensitive to the outside environment and measurement is often used more as a baseline rather than a true temperature measure.<sup>3</sup>

Not recommended for any individual that has difficulty in sitting still/compliance.<sup>3</sup>

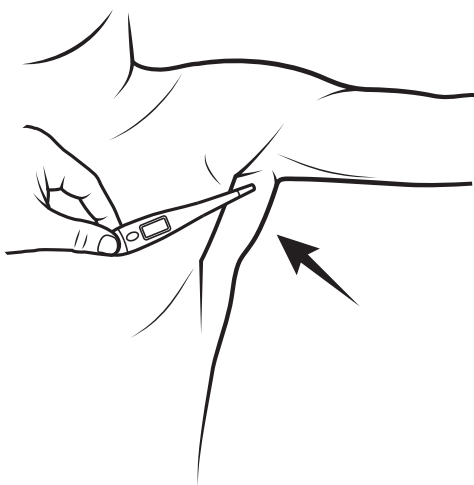
- **This reading is the least accurate of all the temperature readings and should only be used in children who cannot hold the thermometer under their tongue or are unable to use any other measurement site**
- **In children, if the armpit temperature is over 99°F (37.2°C), the rectal temperature should be used<sup>5</sup>**
- **In frail elderly individuals, make sure direct skin contact is evident, as this position may be difficult to achieve for some**

Measurement site should be as high as possible within the armpit with the patient's arm pressed against their side.

The probe should remain in position for as long as it takes to get the measurement (this may be difficult in patients who tend to be more uncooperative).

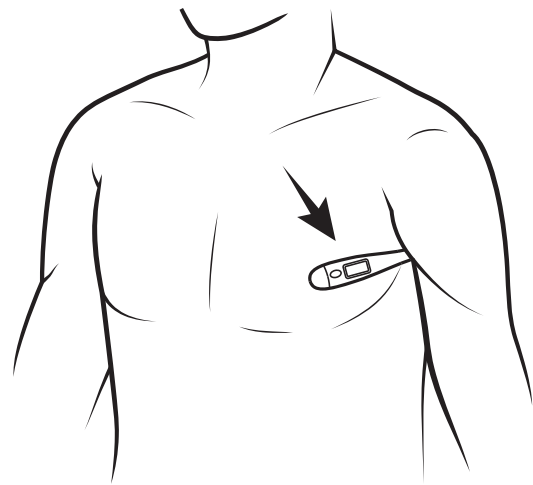
The natural physiology of our body is influenced by the outside environment; therefore, there is natural variability with the armpit as a site for temperature measurement. Factors that influence this temperature reading include:<sup>3</sup>

- Ambient (room) temperature
- Local blood flow
- Underarm sweat
- Temperature differences between right and left axilla of up to 2.52°F (1.4°C) have been reported<sup>6</sup>



## Taking axillary temperature using a clinical digital thermometer (electronic contact thermometer)

1. Ensure you're using the axillary probe (blue cap).
2. Place appropriate probe cover.
3. Do not take an axillary temperature through the patient's clothing. Direct contact between the probe and the skin is required.
4. Lift the patient's arm, exposing the entirety of the axilla.
5. Place the probe as high as possible in the axilla. Do not allow the probe tip to come into contact with the patient until the probe is placed at the appropriate site. Touching any area other than the measurement site/material may cause inaccurate readings.
6. The device will notify the user when a temperature measurement has been achieved.
7. Before removing the probe, record the temperature reading and location of where the measurement was taken from (right or left armpit).



## Infrared ear thermometers (tympanic thermometers)

To avoid the risk for patient cross-contamination and to avoid dirtying the thermometer lens, it's important to use an ear thermometer with the appropriate disposable probe covers.

The use of infrared technology requires that the thermometer be cleaned between uses as a dirty probe can affect temperature readings.

- CDC guidelines recommend the use of 70% isopropyl alcohol to clean thermometers after each use with a cotton swab (nonabrasive material).<sup>7</sup>

A wide range of temperature occurs within the ear canal, increasing the need for correct thermometer position in order to prevent false reads. Incorrect placement in ear canal may be 3.6°F (2°C) lower than actual tympanic membrane temperature.<sup>8</sup>

- **Make sure to remove any hearing aids. Wait 5–10 minutes before taking a temperature measurement after immediate removal of any hearing devices.**

Through safety of design, the device cannot penetrate the eardrum, a fear that many users are met with. The device cannot hurt the patient as its design prevents the ability to go further than its proper point of placement.

- **Readings may be affected by earwax (cerumen) that is blocking the ear canal. Blocked ear canals can show a mean temperature that is 0.54°F (0.3°C) lower than that of the non-blocked ear canal.<sup>9</sup>**
- **Reading may be affected by an ear infection. Infected ears have an approximately 0.9°F (0.5°C) higher temperature than non-infected ears.<sup>8</sup>**

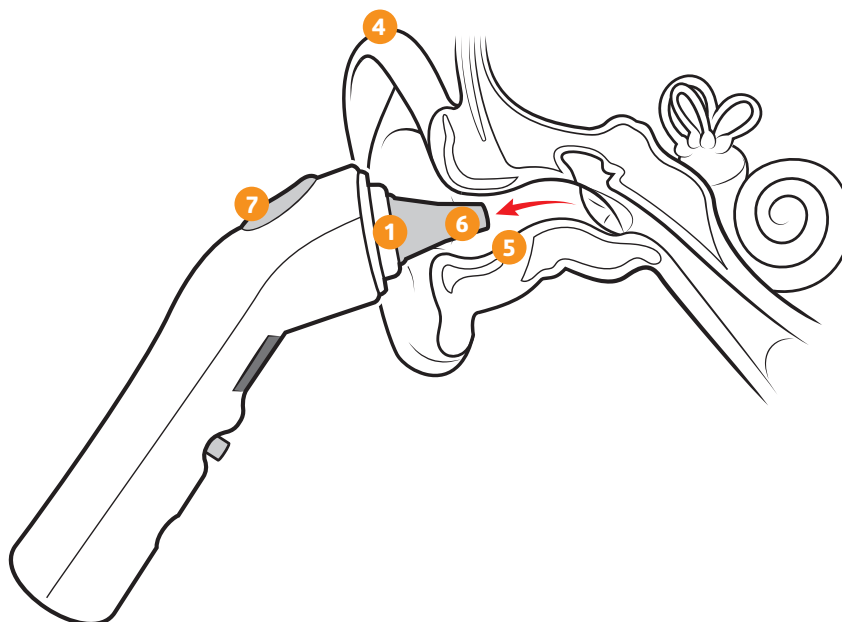
Lying down on a pillow with the head to one side may affect temperature readings, have the patient be free from any pressure on the ear.<sup>3</sup>



MDS8700

### Taking tympanic temperature using the infrared ear thermometer

1. Cover the probe with the appropriate probe cover. This helps to maintain accuracy of the reading and hygiene.
2. Assist the patient into a comfortable position with the head turned to the side, away from the healthcare worker. Patient can be held in parent's arms or sit on parent's lap.
3. If using right hand to hold the thermometer use the patient's right ear, if using the left hand to hold the thermometer use the patient's left ear.
4. GENTLY pull top of ear (pinna) back, up and out.
5. Insert probe completely into ear, the probe is specifically designed to fit in the ear and will not hurt the patient. Therefore, fit the probe snugly into the ear.
6. With the probe snugly fit in the ear canal, do not move, depress the scan button, or leave the probe in place until the reading is complete.
7. Record the measurement site, right or left ear, and properly dispose of the probe cover.



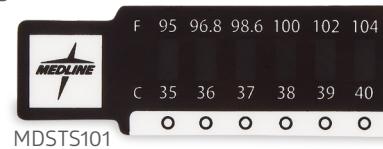
## Forehead thermometry

- The infrared sensing forehead thermometers is a non-contact device, decreasing the risk of cross infection.
- Thermometer uses infrared sensing technology as it is positioned parallel to the forehead from a distance of about one inch away to obtain a proper temperature reading.
- Because this thermometer relies on infrared scanning technology it's important to make sure the device is properly cleaned without the use of any abrasive material.
- Avoid touching the infrared sensor directly with your fingers.
- CDC guidelines recommend the use of 70% isopropyl alcohol to clean thermometers with a cotton swab (nonabrasive material).<sup>7</sup>
- **If the no-touch thermometer touches the patient's forehead skin during use, properly clean the device before use on the next patient. Refer to user manual for troubleshooting tips.**
- General considerations when taking temporal temperature include: avoiding any temperature readings for at least 30 minutes after any physical activity, bathing, swimming, consuming any food or beverages, or spending time outdoors.



## Disposable forehead thermometer strip

Mainly used in surgery and acute care centers. Thermometer consists of a matrix of temperature-sensitive dots for tracking changes in body temperature during procedures. White dots below each temperature reading can be marked for easier tracking during continuous temperature monitoring needs.



## What can cause differences in temperature readings?

- **Measurement site**—Dependent on where the reading is being taken (See Table 1)
  - **Age**—Older adults (age  $\geq 60$ ) have a lower temperature than younger adults (age  $< 60$ ) by approximately  $0.41^{\circ}\text{F}$  ( $0.23^{\circ}\text{C}$ ).<sup>1</sup>
  - **Time of day**—Normal body temperature is lower in the early morning and higher in the evening, varying  $0.9^{\circ}\text{F}$  ( $0.5^{\circ}\text{C}$ ) over the course of the day.<sup>4</sup>
  - **Recent physical activity**—Recent physical activity can increase body temperature. Wait at least 30 minutes before undergoing any temperature readings.
  - **Ovulation**—Normal body temperature will show a noticeable increase of approximately  $0.5$  to  $1^{\circ}\text{F}$  ( $0.3$  to  $0.6^{\circ}\text{C}$ ) shortly after ovulation.<sup>10</sup>
  - **Circadian rhythm**—Temperature varies with the sleep and wake cycle. This varies with the time of day. Recordings in the morning are approximately  $0.9^{\circ}\text{F}$  ( $0.5^{\circ}\text{C}$ ) lower than the evening.<sup>6</sup>
  - **Medical conditions**—Any general medical condition that can affect temperature readings must be taken into consideration. This includes, but is not limited to, thyroid disorders, endocrine abnormalities, infections, metabolic disorders, etc.
  - **Environment**—It's recommended to take temperature readings in an ambient room. Environments that are too hot or cold can significantly affect temperature readings.
  - **Medications**—Many medications can affect temperature output resulting in “drug fever.” Determine if any medications in use are heat-interacting medicines.
  - **Anxiety**—Through the nervous systems “flight or fight” response there is a natural propensity to increase body temperature through blood vessel constriction and sweating. This is very common in individuals with anxiety or those who are generally fearful of doctor's office visits.
1. If the forehead is covered with sweat, dirt, or hair, or makeup has been applied, clean the area and wait 10 minutes before taking a measurement.
  2. Position the thermometer approximately one inch from the forehead in a parallel manner.
  3. Hold the thermometer and the forehead steady during measurement as movement may impact temperature readings.
  4. Once the thermometer is appropriately positioned and the measurement has begun, do not attempt another simultaneous measurement, as the process will restart.
  5. The device will make a signal once a measurement has been attained.

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