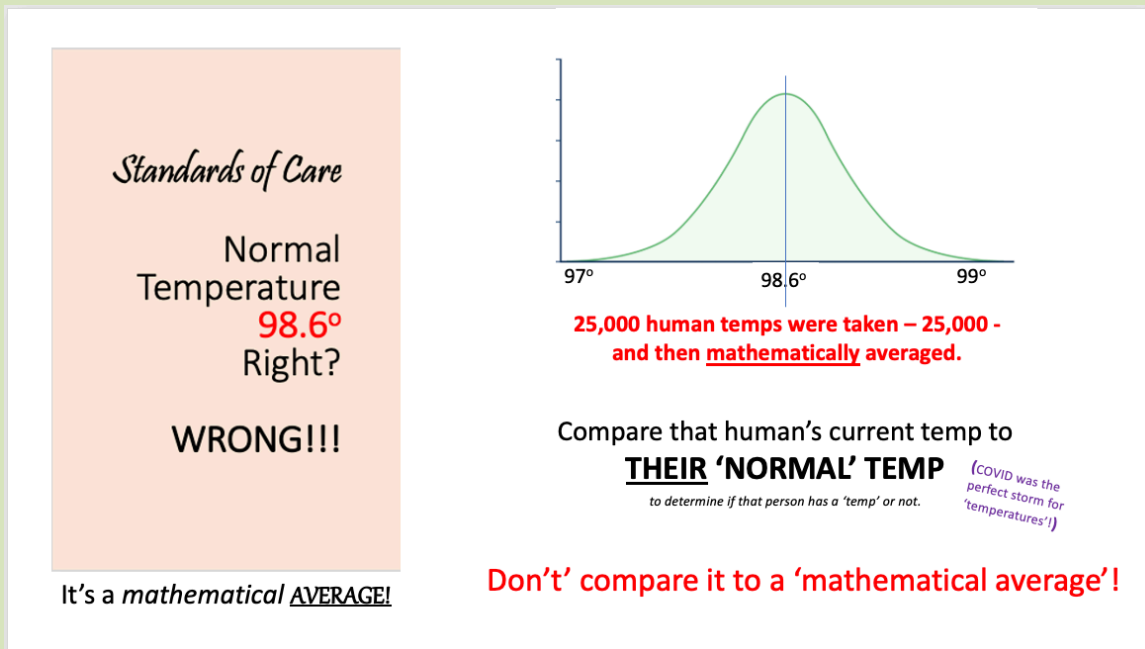


STEM Vital Signs

TEMPERATURE – What is ‘The Science Behind Temperature’ – the STEM of it?



Abstract

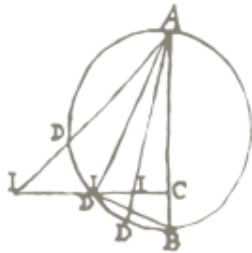
The concepts of fever and normal body temperature have been around for **400+** years. And the practice of Medicine & Nursing - have been using 98.6° for the last **200** years as their indicator for NORMAL.

How did 98.6° come to be? Who determined that? Where on planet earth was this decision made? And is it time for a change? Let's see the history.

History Of Temperature

1600s

Sanctorio Sanctorius was thought to be one of the first to measure temperature – in the **1600s**. at the Max-Planck Institut, in Germany.



MAX-PLANCK-INSTITUT FÜR WISSENSCHAFTSGESCHICHTE
Max Planck Institute for the History of Science

And not much (as recorded by history) happened with that discovery or observation – keep in mind, Nursing was not even a thought at this point in history.

1724

Enter the Mercury Thermometer to the story in **1724** **Physicist Daniel Gabriel Fahrenheit** of Danzig, Poland – that's where the name **Fahrenheit thermometer** came from...(Celsius & Fahrenheit).

In **1724**, a German instrument-maker named Gabriel Fahrenheit produced a temperature scale that now bears his name. He manufactured high-quality thermometers with mercury (which has a high coefficient of expansion) with an inscribed scale with greater reproducibility. It was this that led to their general adoption. Aug 23, 2019

 National Institutes of Health (NIH) (.gov)
<https://pmc.ncbi.nlm.nih.gov/articles/PMC7120475>

[History of the Thermometer - PMC](#)

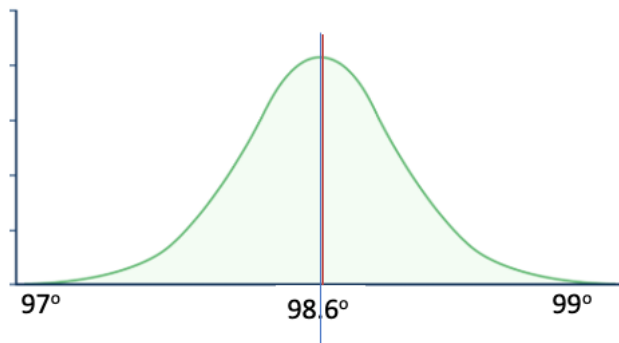
The mercury thermometer was used for the next 240 years.



1851

Then, in **1851**, along came Carl Reinhold August Wunderlich of Leipzig, Germany. He took the temperatures of 25,000 humans, using the mercury thermometer with temps ranging from 97°-99°. Then he **calculated a mathematical average** of those findings.

A mathematical average means that you add all 25000 values (71 + 98 + 99+, etc) and take that TOTAL, and then divide by 25000, and you end up with 98.6°. **And from then on 98.6° was deemed NORMAL.**



25,000 human temps were taken – 25,000 - and then mathematically averaged.

Can YOU already see the problem with this logic?

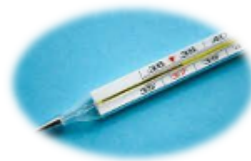
Patient 1:

'Normal' Temp: 98.6

Presenting temp: 100.4

INCREASE 1.8°

Conclusion: patient has a FEVER



Patient 2:

'Normal' Temp: 96.8

Presenting Temp: 98.6

INCREASE 1.8°

Conclusion: patient has a 'NORMAL' temp

Then more parameters were added: what NUMBER indicates what LEVEL of normal, or sick?

Medically, we refer to abnormalities in core temperatures as:

1. **Normothermia:** Normal temperature ranging from 36-37.5°Celsius (96.8-99.5°Fahrenheit)
2. **Febrile/ Pyrexial:** (Fever) A temperature higher than 37.5°C (99.5°F)
3. **Hyperthermia/ Hyperpyrexia:** A temperature above 41.1°C (106°F)
4. **Hypothermia:** A temperature lower than 35°C (95°F)



thenursingjournal.com

<https://www.thenursingjournal.com> › post › measuring-...

[Measuring Body Temperature – Nursing Skills](#)

Harvard

High fever in adults

While any temperature above your normal temperature range is considered a fever, there are different levels of fever severity: Low-grade: 99.1 to 100.4 F (37.3 to 38.0 C) **Moderate-grade:** 100.6 to 102.2 F (38.1 to 39.0 C) High-grade: 102.4 to 105.8 F (39.1 to 41 C). May 22, 2023



Harvard Health

<https://www.health.harvard.edu> › treating-fever-in-adults

[Fever in adults: when to worry - Harvard Health](#)

Note: Harvard referenced 'YOUR normal' but then didn't adjust the categories!

Now NURSING gets to make its contribution to this Vital Sign and create a whole new scale for Temperatures.

So, shouldn't the NEW rule be:

1. Patient's normal temp + 0.4° means FEBRILE
2. Patient's normal temp + 0.5-1.8° means **Low-grade**
3. Patient's normal temp + 2-3.6° means **Moderate-grade**
4. Patient's normal temp + 3.8-7.2° means **High-grade**

Example: Patient X has a NORMAL temp of **97°**

97.4 FEBRILE
97.5 – 98.8 Low-grade
99 – 102.6 Moderate-grade
102.8 – 104.2 High-grade

2019-2020

Then came along the '**Gold Standard**' in temperature, **measured through a catheter in the Pulmonary Artery** – by Swan & Ganz (the Swan-Ganz Catheter!). P.S., this 'gold standard' is based upon Wunderlich's work.



Discover Magazine

<https://www.discovermagazine.com> · Health ·

Body Temperatures Today are Lower Than They Were Two ...

Jan 9, 2020 — That gold standard is based on the work of German physician Carl Reinhold August Wunderlich who, in 1851, collected temperature measurements ...



ScienceDirect.com

<https://www.sciencedirect.com> · science · article · pii ·

Intra-operative temperature monitoring with two non ...

by FJ Gómez-Romero · 2019 · Cited by 24 — The measurement of core body temperature in the pulmonary artery via a **Swan-Ganz catheter** is regarded as the gold standard,^{11, 12} and the rest of t...
Missing: Gana | Show results with: Gana

While we don't 'routinely' measure body temperature that way today, it is part of the **STEM history**.

To this day, Wunderlich's experiment, with his mathematical average, remains the **RULE** – 98.6° remains the rule for all humans.

Now we have 'flawed' NUMBER to live by and measure by.

But what else must be considered? What else influences that 'reading'? The type of temperature reading device, and/or the correct use of the device all can affect the reading.

Because that mercury thermometer took too long, and it needed sterilized or covered, and inserting it into orifices was sometimes complicated, new tools were developed. Enter the next generation temperature taking.

The first non-contact radiometer designed to measure body temperature in the inner ear canal was invented in 1964 by Theodor Benzinger, when doing research on human temperature regulation at the US Naval Medical Research Institute in Bethesda.

Here is a picture pulled from the following Biology (Basel) article depicting the current devices used to measure body temperature.

Figure 1.





[Open in a new tab](#)

Selected thermometry devices. Left to right: Welch-Allyn digital sublingual, Wellworks infrared forehead, Braun infrared tympanic, MOBI infrared forehead, Withings temporal artery, Braun digital sublingual, 3M zero heat flux, FLIR One thermal imaging camera.

Without going any further into the origins and developments of each tool, let's jump in and compare the efficiency and efficacy of the tools that are in use today – because it is that temperature 'number' we are after.

And this next article does just that. Read at your convenience. But the conclusion has been posted here for you.



▶ *Biology* (Basel). 2021 Dec 15;10(12):1327. doi: [10.3390/biology10121327](https://doi.org/10.3390/biology10121327) 

Studying the Accuracy and Function of Different Thermometry Techniques for Measuring Body Temperature

[Aaron James Mah](#) ^{1,2,*}, [Leili Ghazi Zadeh](#) ^{1,3}, [Mahta Khoshnam Tehrani](#) ^{1,3}, [Shahbaz Askari](#) ^{1,4}, [Amir H Gandjibakhche](#) ⁵, [Babak Shadgan](#) ^{1,2,3,4}

5. Conclusions

We demonstrated that tympanic thermometers are the most accurate commercially available system for the regular measurement of core body temperature. Furthermore, the results of this study suggest that the tympanic thermometer provided a more accurate body temperature reading when used in the left ear. The temporal artery thermometer, infrared forehead thermometer, digital sublingual thermometer, zero heat flux thermometer, and thermal imaging camera all demonstrated a significant temperature difference from the gold standard. Tympanic thermometers can help individuals with regular self-assessment of their body temperature, which is a useful tool in lowering the spread of infectious diseases such as COVID-19.

Did you get that – this conclusion of this research tells us that the **Tympanic Thermometers provided a more accurate temperature (when used in the left ear).**

Can you, now, begin to appreciate how important this **VITAL SIGN** is and how important the **accuracy** of this vital sign value is to the patient, to the doctor, to the entire medical process?

What does the word **VITAL** mean - important to **LIFE**.
The Temperature VS should be taken **SERIOUSLY**.

We all tried to take ‘Temperature’ seriously during Covid. What impact did ‘Temperature’ have on the Covid Crisis? Wasn’t every human being tested for body temperature as they entered almost every building?

► [Open Forum Infect Dis. 2020 Dec 14;8\(1\):ofaa603. doi: 10.1093/ofid/ofaa603](#) [↗](#)

Why Temperature Screening for Coronavirus Disease 2019 With Noncontact Infrared Thermometers Does Not Work

[William F Wright](#)^{1,✉}, [Philip A Mackowiak](#)²

► [Author information](#) ► [Article notes](#) ► [Copyright and License information](#)

PMCID: PMC7798604 PMID: [33506067](#)

Abstract

Coronavirus disease 2019 screening can evaluate large numbers of patients while reducing healthcare exposures and limiting further spread of the virus. Temperature screening has been a focal point of case detection during the pandemic because it is one of the earliest and most frequently reported manifestations of the illness. We describe important factors to consider of screened individuals as well as the measurement process and current outcomes. Optimal temperature-based screening involves both individual and environmental factors as well as reconsideration of the current fever threshold.

How many Covid cases did we miss because half the population has a normal below 98.6° – but when the thermometer read 98.6° we called it “NOMRAL” – come on in?

To round out our review, let’s add 2 ‘opinion’ pieces and 2 science pieces.

NOTE: Date of
article.

The Nurses' Station Patient News

www.TheNursesStation.org

Vol. 1

1/8/2018

98.6° May Not Be Your NORMAL Body Temp



Written by: M. Gail Stotler, BSN, RN

What do you mean, isn't 98.6° everyone's normal?

Nope. Not everyone has a normal body temp of 98.6°.

Let's cite Harvard Medical School for this:

Normal Body Temperature:
Rethinking the normal
human body temperature.
Published April 2006

According to the article, Dr. Wunderlich's original 19th century definition of normal has been debunked.

The bottom line is that individual variations in body temperature should be taken into account, reports the *Harvard Health Letter*.

Short of this, recognize that 98.6° isn't the benchmark that we've long believed it to be.

What does this mean? It means that you need to have your normal body temp checked and then recorded on paper.

Here is why that is SO important.

The medical profession considers 98.6° as normal and anything 100.4° and higher as very sick. [98.6° / 100.4°]

But if your true normal is 96.8°, then a reading of 98.6° for you means you have a high fever and are very sick. [96.8° / 98.6°]

So, here's the problem. If your ABNORMAL is 98.6°, then when you go to the ER or to the doctor, and they measure your temperature, and it reads 98.6°, they will think that you are NORMAL.

And you are NOT normal at 98.6°. In fact, you are very sick at 98.6°.

That is when you present your **Normals ID** card and tell them that your true normal is 96.8° and that you are, in deed, very sick.

How many school nurses have told a child and that mom that the child is not sick, 'there is no temp', meaning that the child's temp was "normal" - by their standards. No one meant harm, but harm was done. And it's not just the school nurse, it's the paramedic, the ER doctor, the floor nurse, and even our own 'doctor' mom.

So how do you get an accurate body temperature reading?

The old-fashioned mercury thermometer is the best. So, if you have one of those at home, place it under your tongue, with your mouth shut, for 5 full minutes - then read it. But there are many devices out in the market today to take a temperature, and not all of them work well.

To keep it really simple, have your doctor's office

check your temp the old-fashioned way while you are there and record it, or visit *The Nurses Station*, and we will check it for you and record it.

Temperature is just one of the Vital Signs that you should have checked, and recorded, and kept in your wallet at all times, just in case there is a need to know this VITAL information.

We hope that you found this article useful and informational.

And, if you did, we will be publishing a **Patient News** paper once a month.

The next article will be about *Cholesterol: Not just the good, the bad, and the ugly - but don't we need some of it, and why?* [Let us know if you want it.]



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Please tell your friends!

This article was written in January 2018.

Covid started in January 2019.

Just think, if somebody had been paying attention to this article, how many more Covid patients would have been recognized sooner.....

instead of measuring everyone against 98.6° and allowing how many more into the building?

IMAGINE!

Let's see what writer Sarah Kuta has to say on this subject.



October 16, 2023

What's Really the Average Human Body Temperature? By Sarah Kuta

Long thought to be 98.6 degrees Fahrenheit, the measurement is highly personal and varies depending on time of day, among other factors, new research finds

For decades, 98.6 degrees Fahrenheit has been the widely accepted "normal" average temperature for the human body.

But new research adds to the growing body of evidence that humans actually run a bit cooler. In addition, the study suggests there's no such thing as a "normal" body temperature, because readings vary greatly depending on a variety of factors, from the person's age to the time of day.

Researchers described these and other findings last month in *JAMA Internal Medicine*.

Scientists analyzed the oral temperature measurements of more than 126,000 adults seen at Stanford Health Care between 2008 and 2017. They also compiled information about each patient, such as their height, weight, sex and age, and made note of the time of day each temperature was taken.

They found the average human body temperature to be around 97.9 degrees, nearly a degree lower than 98.6. But are humans actually getting cooler? Maybe, but maybe not.

The belief in the 98.6 degree average dates back to 1868, when German physician Carl Wunderlich took more than a million temperature measurements from 25,000 people.

But a lot has changed in the world of scientific and medical research over the last 150 years, so holding up today's studies against Wunderlich's may not necessarily be an apples-to-apples comparison.

"Statistics were not in common use then, much less computers," Philip Mackowiak, a physician at the University of Maryland, told *National Geographic's* Brian Gutierrez last year. "So how he could have processed a million data points and come up with the results that he did, it's just impossible to imagine."

Where on the body Wunderlich took the patients' temperatures may also have something to do with the difference. For instance, oral temperatures tend to be lower than rectal temperatures.

In addition, 98.6 degrees was simply the number that stuck in the public consciousness when, in reality, Wunderlich reported a range of temperatures. He also noted that measurements varied depending on the time of day, as well as patients' age and sex.

"Instead of thinking about a distribution in temperatures, which is what the initial study showed, we've taken a mean of 98.6 F and used it as a cutoff value," says Catherine Ley, an epidemiologist at Stanford University who co-authored the new study, in a statement. "We've used an average value to create a false dichotomy of what's normal and what's not."

It is also possible that average body temperatures have dropped in recent decades because, by and large, humans are getting healthier. Thanks to advances in medicine and dentistry, patients are dealing with less inflammation than they likely were 150 years ago, reports the *New York Times's* Dana G. Smith.

The new study also finds variations in temperature depending on patient characteristics and time of day. For example, women tend to

run hotter than men. Older people tend to have lower temperatures than younger people. And, among all demographics, temperatures tend to be lower in the morning and higher in the afternoon. (If you're curious about what your temperature might be throughout the day, the team also built an online [personalized temperature range calculator](#) using their findings.)

An elevated temperature, or fever, suggests the body might be fending on some sort of infection—and that means the immune system is doing its job. Fevers are “actually not necessarily something we have to eliminate at all times,” says [Angela Mattke](#), a pediatrician at the Mayo Clinic, to [CBS News’ Aliza Chasan](#).

But, since there's so much variability in body temperature, a high reading for one person could be normal for someone else. Taken together, these and [other recent findings](#) suggest doctors should rethink the temperature benchmarks they use to determine when a patient is healthy and when something might be wrong. Individualized temperature evaluations and personalized fever thresholds might be more useful than comparing everyone to the average, the researchers say. For example, a doctor might consider how a patient's current temperature compares to their historical readings.

“Most people, including many doctors, still think that everyone's normal temperature is 98.6,” says study co-author [Julie Parsonnet](#), also an epidemiologist at Stanford, in a statement. “In fact what's normal depends on the person and the situation.”

By Sarah Kuta

Sarah is an award-winning Colorado-based writer and editor, writing about travel, lifestyle, food and beverage, fitness, education and anything with a great story behind it. And this Temperature story is a great story.

It's also an important one – a vital one. Temperature is a VITAL SIGN.

Here are two more articles on the subject, one by Yale and one by Harvard, 2020 and 2023, respectively. These are both very reputable institutions. Read at your convenience.

 Yale Medicine
<https://www.yalemedicine.org/news/temperature-che...>
Is 98.6 Degrees Really a 'Normal' Temperature?
Jul 30, 2020 — One recent study that looked at 250,000 temperature measurements from 25,000 British patients found the average to be 97.9° F.

 Harvard Health
<https://www.health.harvard.edu/blog/time-to-redefin...>
Time to redefine normal body temperature?
Sep 12, 2023 — ... temperatures from about 25,000 people and found that the average was 98.6° F (37° C). And so, we've believed that ever since. You might also ...

Hopefully you a viewing 'Temperature Taking' in a whole new light. Hopefully, the next temp you take, or the next person you teach, you will be even more thoughtful of than number and before you read this article.

Every school Nurse, every MOM, every CNA, every Medical Assistant, every Paramedic, every hospital and doctor's office Nurse, every Doctor, and every INDIVIDUAL needs to know this story.

EVERY HUMAN BEING needs to KNOW THEIR NORMAL.

So, as part of your continuing education, I strongly advise that you determine YOUR normal body temp with an accurate device and an accurate reading, and then WRITE IT DOWN.

And, do your own research, study your own 100 patients and map your own Bell Curve findings – and, hopefully, come to the same conclusion. [PS. If you conclusion differs, please call Yale or Harvard.]

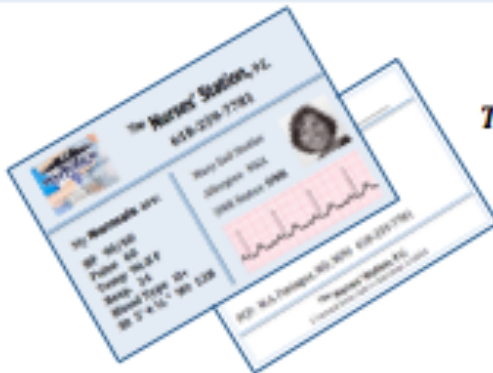
And at the end of this STEM Vital Signs Continuing Education, I hope you will all create your own **Normals ID** card – it could be critical to your care.

F.Y.I

*If you have your health,
you have everything.*

- ✓ BP
- ✓ Pulse
- ✓ Respirations
- ✓ Temp
- ✓ EKG
- ✓ Blood type

Know Your Numbers!



The Nurses' Station

has a ***Normals ID*** card
-just for you.

Don't wait till you're sick to try and figure out just how sick you are - get your baseline information on a *Normals ID* card. Now the paramedic, nurse, and doctor have something to compare the 'sick' numbers to.

This package includes: Your Dr's name, medical condition(s), Allergies, DNR status.

Vital Signs:

BP – Blood Pressure
Pulse – Rate and Rhythm
Respirations
Temperature – *normal isn't always 98.6 – what's your normal?*

EKG: (electrocardiogram)
Heart strip.



Your EKG is unique,
like your finger print.

Blood Type:

O+ O-
A+ A-
B+ B-
AB+ AB-
What's your
blood type?



The Nurses' Station, P.C.
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Here are the Questions:

1. For how many years have people been observing body temperature?
 - a) 1200 years
 - b) 60 years
 - c) 400 years

2. Who deemed 98.6° as normal?
 - a) Sanctorio Sanctorius
 - b) Carl Wunderlich
 - c) Sarah Kuta

3. What year was that discovery and declaration made?
 - a) 1851
 - b) 1636
 - c) 1965

4. How many people/patients were involved in the Wunderlich research?
 - a) 250,000
 - b) 25,000
 - c) There were no studies

5. Where was the research done?
 - a) University of Leipzig, Leipzig, Germany
 - b) Greece
 - c) In the U.S.A.

6. Which temperature gauging device has been determined to be the most accurate?
 - a) Tympanic/Otic Thermometer
 - b) Mercury Thermometer
 - c) Forehead Infrared

7. What does the word VITAL mean?
 - a) Important to LIFE
 - b) It's just name

8. What is YOUR normal? _____

9. Which 'temperature access point is most accurate when using a mercury thermometer?
 - a) Rectal
 - b) Oral
 - c) Axillary

10. Why should we care about that Temperature reading

CE request

1. Provide your: Name
Street Address
City, State Zip
RN License (State) Number
LPN License (State) Number
2. Copy and paste the questions to an email.
ADD your answers to the questions – highlight the letter or type a response.
3. Send the email to: mgailstotler@gmail.com

This information will be forwarded on to CEII (Continuing Education Institute of IL)

Your CE will be issued by CEII and will be emailed to you, for your records.

If you have any questions, or comments, please contact Gail at the above email address or call 618-259-7781.