Fever: What's in a Number?

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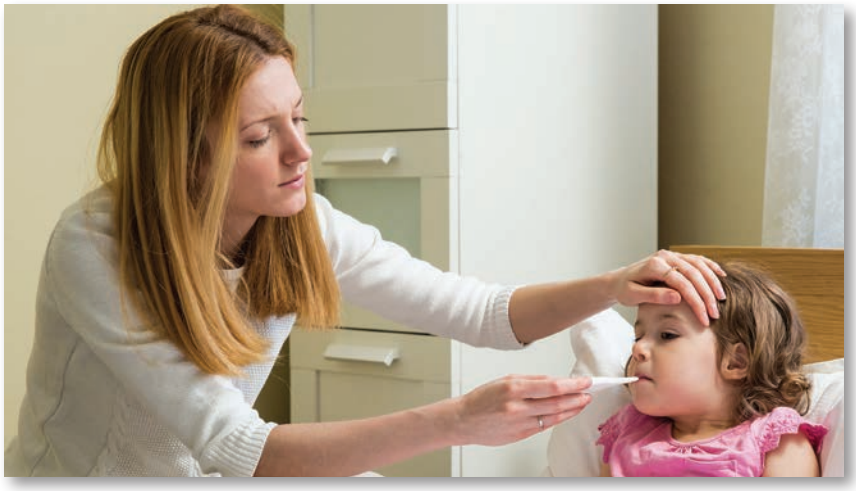
98.6°F stands the test of time as what's normal.

Practice Perfect is a continuing every-issue column in which Dr. Shapiro offers his unique personal perspective on the ins and outs of running a podiatric practice.



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As a kid, my very Jewish mother would use her hand to determine if there was a fever, as if the palm of her hand was somehow a calibrated medical instrument capable of determining illness or health. Always a source of wonder about the accuracy and precision of this very cheap thermometer—caused one to sit quietly for fear she would pull out a thermometer and try to be more "accurate" by going the rectal route. Yes, another aspect of Jewish mothers seems to be the opinion that rectal temps are best. These days, with the onset of COVID-19, fever is always on our minds. We're taught in school the importance of this first vital sign and I have even caught myself performing that oh-so-accurate palm-on-the-forehead maneuver—much to my own kids' annoyance. Oh, how we are bound to repeat the actions of our parents, though it has never come down to sticking a thermometer in either my kids' or my patients' butts! Is a temperature above 98.6° Fahrenheit (F) a fever? Where did 98.6 come from? Is fever even a reasonable vital sign? Let's take a look at some of the literature and learn a little more about it.

From Where Does 98.6 Come From, and Is It Valid?

Carl Reinhold August Wunderlich (1815-1877) is given the most credit for the 98.6°F (37.0°C) number. Dr Wunderlich was born at the time that Otto Von Bismarck was unifying Germany into one country. His work on clinical thermometry established the "normal" temperature in 1871 as a range in which 98.7°F is the average with 100.4°F (38.0°C) as the upper limit of normal.[1] He reportedly looked at 1,000,000 axillary temperatures from 25,000 people and described a diurnal variation in temperature.[2] (Could you even imagine 1,000,000 rectal temperatures? Wow, that would be bad!). One hundred-forty-nine years later, we're still using these numbers in clinical practice. That's staying power! In 1992, Mackowiak and colleagues attempted to verify Wunderlich's work.[2] Although Wunderlich examined a lot of people, his choice of examination methods (the axillary temperature) was not the most accurate. These modern researchers studied 148 men and women as part of a larger vaccination trial at the time using oral temperatures measured 1-4 times daily for three consecutive days (total of 700 recordings) using a digital thermometer. They found a mean temperature of 98.2°F (36.8°C) with an upper limit of 99.9°F (37.7°C) and a diurnal variation in both men and women with a 6 AM nadir and 4-6 PM zenith. They recommend abandoning the 98.6F number and instead using 37.2°C (98.2°F) in the AM and 37.7°C (99.9°F) in the PM. Consider that Wunderlich was only off by 0.4°F—not bad for 149 years ago!

Much more recently, in 2019, Harding, et al. performed 93,225 temperature recordings using tem-

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poral artery thermometers.[3] They found a mean body temperature of 98.1°F (36.7°C) and range of 36.0°–37.5°C (96.9°–99.5°F). Similar to the prior studies, they found a diurnal cycle to body temperature with the nadir between 6-8AM and a zenith between 6-8PM. Both of these studies advocate for the elimination of the 98.6°F number as being scientifically irrelevant, but I can't help but think they are straining at the gnat and swallowing the camel—they're missing the point. The difference between recent research and Wunderlich's from almost 150 years ago is relatively small, and they don't entirely eliminate the old 98.6°F number.

Let's Bottom Line This!

The basic take home points from this are as follows:

1) 98.6°F is close but not quite on the money as a single number for normothermia and should probably be discarded.

2) Normal body temperature ranges around 36.0°–37.5°C (96.9°–99.5°F), but for most healthcare providers hyperthermia is more concerning, so anything above 100.5°F (38°C) is definitely a fever.

3) Temperature ranges according to human diurnal patterns with lowest temps as the sun rises and highest temps as the sun sets. Keep that in mind when treating patients. For example, a temp of 99°F may be more concerning in the morning than in the evening.

4) Elderly patients have a lower resting temperature than younger patients so higher temps are always more concerning.

Good for you Dr. Wunderlich. Considering how much medicine from the 1800s has been completely disproven, he got it pretty darn close. Just keep that rectal thermometer away! **PM**

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References

[1] Mackowiak PA, Worden G. Carl Reinhold August Wunderlich and the evolution of clinical thermometry. Clin Infect Dis. 1994 Mar; 18(3):458-467.

[2] Mackowiak PA, Wasserman SS, Levine MM. A critical appraisal of 98.6 degrees F, the upper limit of the normal body temperature, and other legacies of Carl Reinhold August Wunderlich. JAMA. 1992 Sep 23-30; 268(12): 1578-1580.

[3] Harding C, Pompei F, Bordonaro SF, McGillicuddy DC, Burmistrov D, Sanchez LD. The daily, weekly, and seasonal cycles of body temperature analyzed at large scale. Chronobiology International. 2019 Dec 2; 36(12):1646-1657.

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