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Redefining 'Normal' in Human Physiology: Personalized Physiological Fingerprint

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What does it mean to be "normal" in human physiology? A blood pressure of <120/80 mmHg, a resting heart rate of 72 beats per minute, a fasting glucose of <100 mg/dL-these figures are enshrined in textbooks as universal reference points. Yet they are averages, not absolutes. For one person, they may represent good health; for another, an early sign of disease. The time has come to ask whether population-based reference ranges are enough, or whether physiology should instead be anchored in the unique patterns of each individual. While precision medicine, concerned with genomics, epigenomics, and proteomics is fascinating, its implementation remains a challenge![1] However, normal physiological parameters can be of great help!

Traditional norms arise from large population studies, useful for screening and diagnosis but blind to individual variability. Age, sex, ethnicity, fitness, circadian rhythms, and environment all shape physiology. A heart rate of 60 beats per minute may be a healthy baseline for an endurance athlete but a red flag for someone else. A fasting glucose of 100 mg/dL may fall within the accepted "normal" range yet still represent a deviation for a person whose usual value is 80 mg/dL. By treating averages as absolutes, we risk missing early disease on one side and overtreating healthy variation on the other.

The alternative is to measure physiology during health and use those data as the benchmark during illness.[2] With wearable sensors and continuous monitoring, individuals can now track variables such as heart rate, blood pressure, respiratory rate, oxygen saturation, body temperature, sleep patterns, and glucose levels. Over time, these create a personal physiological fingerprint-a baseline of what is normal for that person. This baseline can be far more informative than any textbook value (Figure 1). A shift from a personal resting heart rate of 58 to 72 beats per minute, or from a baseline blood pressure of 90/60 to 120/80 mmHg, may represent the first signal of stress, infection, or cardiovascular strain.

Artificial Intelligence (AI) makes this approach clinically actionable. Algorithms can analyze large volumes of personal data, detect subtle deviations, and correlate them with early disease states, environmental exposures, or treatment responses.[3] With enough longitudinal data, AI could predict illness before

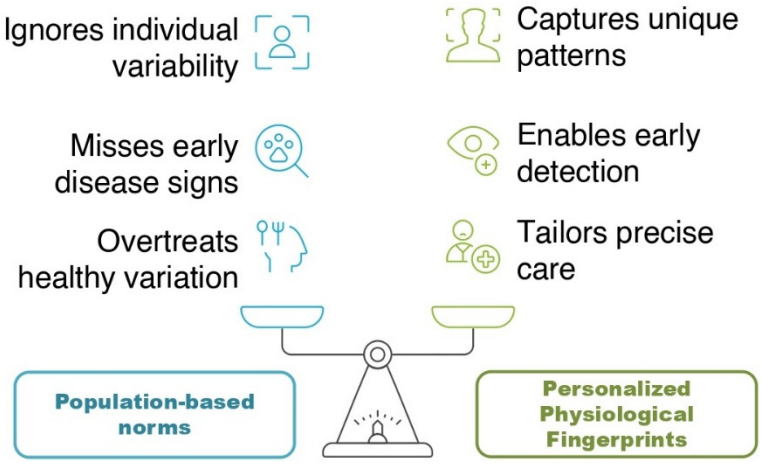

Figure 1: Comparison between population-based norms and personalized physiological fingerprint.

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symptoms appear or tailor therapies to the individual rather than the average patient.

Challenges remain. Devices must provide accurate, standardized measurements. Data privacy and security must be guaranteed.[4] In addition, digital device is another challenge where a major part of population cannot afford costly devices required for recording physiological data. In addition, when using AI for healthcare purposes, the AI systems must be transparent, fair, and subject to clinical oversight.[5] And most importantly, the medical community will need robust evidence before moving beyond established reference ranges.

The idea of "normal" in physiology has served medicine well, but it is ready for redefinition. By building personal physiological fingerprints in health, we can detect disease earlier, treat more wisely, and bring precision medicine into everyday practice. It is time to move beyond averages. The real question is not what is normal-but what is normal for you.

CONFLICT OF INTEREST

The author declares that there is no conflict of interest.

ABBREVIATIONS

AI: Artificial Intelligence.

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