THE ARISING

Wearables & Health Signals



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What Wearable Health Measurements Can Tell Us

The best wearable is not the one that produces the most numbers. It is the one that helps you ask a better question.

Begin with the person, not the dashboard

A wearable can turn an ordinary night into a page of graphs. That can be useful. It can also make an uneventful morning feel like a test you have already failed. This issue offers a different starting point: decide what you want to understand, then ask whether a measurement is good enough to help.

Perhaps you want to notice how regularly you sleep, understand the pattern around a demanding week, or bring a clearer account of symptoms to an appointment. Those are different questions. They do not require the same sensor, the same degree of certainty or the same response.

Three layers, three kinds of evidence

A sensor records a physical signal. Software converts it into an estimate. An app may then combine several estimates into a score or recommendation. Each step adds interpretation. Agreement with a reference instrument is one question; whether a score predicts an outcome is another; whether acting on that score improves life is a third. For example, a wearable might count your pulse accurately without its recovery score being able to tell you whether a hard workout is a good idea today.

How to read this issue

The feature sections explain health summaries, recovery scores and overnight patterns. Subsequent sections sort the main signal families and put interpretation into practice, before exploring a study of information hidden in existing heart recordings. Links to the sources close the issue. HRV has its own companion magazine; here it is one component of the wider measurement landscape.

This is general education, not an individualized monitoring or treatment plan. Wearable features depend on model, software, region and eligibility. The manufacturer documentation cited here describes selected implementations as examples. It does not establish what every wearable can measure or whether using a feature improves health.

From sensor to decision

The farther a number travels from the original signal, the more questions we should ask.

Sensed

Light reflected through tissue can track changes associated with blood volume. Movement sensors record acceleration. Temperature sensors record local temperature. A compatible electrocardiogram (ECG) feature records the heart’s electrical signal. None of those raw signals is itself a complete account of sleep, fitness, stress or health.

Estimated

Depending on the wearable and feature, software may derive pulse rate, intervals, sleep timing, stages, breathing rate or activity summaries. The estimate depends on the input quality and the method. One documented sleep-staging implementation combines movement and body signals such as pulse rate rather than directly recording brain activity. [4] That is a different measurement route from a clinical sleep study, and it does not describe every wearable.

Combined

Readiness and recovery scores combine selected inputs using a product-specific model. The examples in the cited documentation use multiple signals, but neither the ingredients nor the calculations should be assumed to match across wearables. Similar-looking scales do not make the outputs interchangeable. [3,5] A score is a compressed interpretation. Open its contributors before assigning it a meaning.

Acted upon

The practical test is simple: what would this information reasonably change? A useful answer might be to check that a sleep interval is correct, record a persistent pattern, or discuss a symptom with a clinician. A weak answer is to pursue the number at any cost. No score is a measure of personal worth, and a reassuring dashboard is not medical clearance.

For every new feature, ask: what is actually sensed; what is inferred; where was it tested; and what action has evidence behind it? A compelling graphic should not get to skip those questions.

Health summaries and notifications

Check what the particular feature does and whether it is available to you.

What it can show

Health summaries and notifications can draw attention to individual measurements or patterns. The cited documentation gives examples of sleep tracking, heart-related notifications and overnight metrics, with availability depending on the configuration. One implementation establishes personal typical ranges and can highlight several readings outside your usual range. [1,2] These examples are not a checklist of capabilities shared by all wearables. Check which measurements your own feature actually uses.

What the context means

A typical range is a description of collected measurements, not a medical diagnosis of normality. The documentation for one overnight summary identifies medications, elevation, alcohol and illness as possible influences on its metrics, warns that poor fit can impair readings, and states that the summary is not intended for medical use. [2] Those instructions belong to that implementation. For any wearable, identify which measurement moved and read its own limitations before treating a dashboard as a verdict.

Cardio fitness is a model

A wearable may offer an estimate of VO2 max, a measure of how much oxygen your body can use during hard exercise, but the inputs and eligible recording conditions must be checked. One documented implementation uses heart and motion data during selected outdoor activities and incorporates personal information and medications that affect heart rate. [6] That description is not a universal recipe. Such a modeled estimate differs from measuring the gases you breathe in and out during a laboratory exercise test. Missing data can reflect eligibility or recording conditions rather than a sudden loss of fitness.

Before relying on a feature

Check the exact wearable, current instructions and country eligibility. Some heart-related features have regulatory authorization for a specific medical purpose; other wellness displays do not. A health notification and a blood-pressure reading are not the same kind of output. Avoid translating a flag into a diagnosis or using its absence to rule out disease. The product page is the starting point for capability, not a substitute for clinical assessment. [1,2]

How Wearables Estimate Recovery

A daily summary can organize attention, provided its ingredients remain visible.

Activity, recovery and sleep

Activity load, recovery and sleep are related questions, but they need distinct explanations. One documented system organizes its summaries around these three areas and calculates a recovery score from several measurements. [3] That example illustrates how measurements can feed a daily summary; it does not establish a standard set of inputs, a shared scoring scale or a performance ranking across wearables. Read the definitions for the feature you use.

Read the contributors

A low recovery result does not identify a single cause. A high result does not guarantee that strenuous activity is appropriate. Ask which input changed, whether the sleep period is correct, and whether a real-world observation supports the interpretation. A score is a modeled summary rather than a physical unit. The cited example uses its own calculations; it does not justify adding scores across systems or using them to rank different people. [3]

A fictional morning

Imagine that a user sees a lower recovery score after travel. They also notice that the recorded sleep interval begins late. The useful question is not immediately "How do I fix my recovery?" It is "Did the device capture the night, and what actually happened?" Correcting a recording mistake and recognizing a disrupted night lead to different conclusions. This example illustrates a reading method; it does not establish the cause of any actual result.

Hardware, membership, intended use

Check the current combination of sensor hardware, any required membership and regional availability before relying on a feature. Features offered within one product family may not be available on every wearable or plan. A wellness recovery score should not inherit medical authority from a separate regulated feature. Check what is included before buying: a useful feature may require a particular device or subscription.

How Wearables Estimate Sleep and Readiness

Overnight measurements can help reveal patterns. Their summaries still depend on a model.

Readiness and its ingredients

Some readiness summaries consider more than the most recent night. In one documented implementation, overnight and longer-term inputs contribute to the score, and selected contributors compare averages that give some recent readings more weight than others with your usual range over a longer period. [5] In that system, yesterday alone may not account for the result. Other wearables may use different time windows or calculations. Check the contributors before comparing days or comparing your result with someone else's.

Sleep stages are inferred

The sleep-stage estimate in this example uses movement, skin temperature, heart rate, heart rate variability (HRV, the small changes in timing between beats) and breathing rate. [4] Its colored sleep graph is an interpretation of those signals, not a recording of brain waves. The exact inputs and performance of another wearable need their own evidence. A staging display should not be read as a minute-by-minute transcript of consciousness. The more useful question may be whether the overall timing is plausible and whether the trend agrees with your experience.

Temperature: identify the measurement

A temperature display may report a change from a personal baseline rather than an absolute temperature. The documented example measures nighttime skin-temperature deviation and distinguishes it from resting body temperature or temperature deep inside the body. [7] That definition applies to the feature described, not every wearable. A skin-temperature deviation cannot be substituted for a clinical thermometer reading or treated as a diagnosis. Label the actual variable when recording it: skin-temperature deviation, not simply "fever."

Keep the useful scale

For an everyday review, separate the score, its contributors and what you felt or did. If several scores use the same inputs, their agreement is not three independent confirmations. Look for genuinely different information rather than counting repeated summaries as additional evidence. Check current hardware, software and any membership requirements before purchase or use; this issue makes no claim that one wearable generation outperforms another.

Interpreting Sleep, Activity and Fitness Trends

A sleep chart, a step count and a fitness estimate answer different questions.

Sleep: timing is not diagnosis

A sleep record can start a useful conversation about when the device thinks sleep began and ended. The American Academy of Sleep Medicine's technology review emphasizes checking accuracy against established methods, consistent definitions and the challenges of interpreting consumer data in care. [8] A wellness staging display should not be treated as a diagnosis of a sleep disorder. Separately authorized clinical features must be assessed according to their own intended use.

A fictional reader might see less deep sleep on a graph while feeling rested. That discrepancy is a reason to examine the estimate and the broader pattern, not to assume that the person has failed at sleep. Persistent sleep concerns deserve attention even when a graph looks reassuring.

Movement: name the unit

Steps are a count, cadence is steps per minute, workout duration is time and a training-load score is an interpretation. They are not interchangeable. A device can miss an activity or classify it differently from another device. When a display changes, first check the recorded activity and collection conditions. Avoid turning a measurement disagreement into a competition between bodies.

Fitness: an estimate has a setting

Check the conditions under which a fitness estimate is produced. One documented model uses particular outdoor activities and user information; those requirements should not be assumed to describe other wearables. [6] An estimate from those conditions should not be treated as if every workout were a fresh laboratory test. A sensible reading record includes the wearable, activity, time window and any software change.

The Sleep, Fitness and Muscle magazines explore these topics further. The useful goal depends on what you want to do in daily life, not on meeting a universal score.

Heart Rate, HRV, Oxygen Levels and Breathing Rate

Heart rate, HRV, rhythm and oxygen saturation describe different things.

Rate, variability and rhythm

Heart rate describes beats per minute. HRV describes small differences in the time between one heartbeat and the next. Rhythm concerns the pattern of electrical activation and beats. A light-based pulse sensor measures blood-volume changes; an ECG records the heart’s electrical activity. A number labeled HRV is not an ECG interpretation, and a favorable HRV number does not rule out an abnormal heart rhythm. The separate HRV companion explains the differences in how readings are collected and calculated in detail.

Oxygen saturation

Pulse oximetry estimates the percentage of oxygen-carrying hemoglobin in the blood that is carrying oxygen, using light. The FDA warns that readings can be inaccurate and identifies factors including circulation, skin pigmentation, skin temperature and other measurement conditions. It recommends considering symptoms alongside readings. [9] The same percentage symbol does not prove that a consumer wearable has the same performance or intended use as a medical device.

Breathing rate

A breathing-rate display may be inferred from other signals rather than directly counting airflow. Read the specific method and time window. An overnight average and an event-detection feature are different outputs. A plausible average cannot by itself establish that no breathing problem occurred. A new persistent pattern is more useful to discuss when the record also identifies symptoms, context and the device involved.

The safety boundary

Do not wait for a low score or a warning if you have severe or sudden symptoms such as chest pain, serious difficulty breathing or fainting: seek urgent medical help. Do not change medicines or prescribed oxygen on the basis of a wellness dashboard. For an unexpected non-urgent result, follow the device instructions and seek medical advice if you are concerned. The FDA's guidance is explicit that readings should be interpreted with the person's condition, not in isolation. [9]

Different measurements, different methods

A measurement family deserves its own explanation before it becomes another tile.

Blood pressure

An alert about possible high blood pressure, a measurement from an inflatable cuff and an estimate made without a cuff are different things. Before recording a value as blood pressure, identify the instrument, units, method and intended use. Do not assume that a wearable provides a blood-pressure measurement or that its output is interchangeable with a clinically validated measurement. Look for evidence that the specific method gives accurate readings and whether it needs regular checks against a reference instrument.

Temperature, glucose and composition

A skin-temperature trend is different from core temperature; the cited documentation illustrates that distinction for one feature. [7] Glucose monitoring and assessment of body fat and other tissues also require their own measurement methods. Do not assume that a wearable directly measures every biological quantity shown in an app. Each category requires its own evidence, population, limitations and interpretation.

For glucose in particular, the question and standard of care differ between established diabetes management and exploratory consumer use. This overview supplies no glucose targets or treatment advice. Whether a glucose monitor helps depends on the system, the person using it and the decisions it supports.

Biological-age numbers

An age estimate is another model output, not a direct observation of years added to life. A display can change because inputs or algorithms changed. Reading an estimate responsibly means asking what was validated and what outcome it predicts. Biological-age Clocks is the existing Arising home for that deeper discussion.

A calmer way to read the day

A few questions to help you understand a display. They do not replace medical advice.

First, name what changed

Write the actual measurement, its unit and the period it covers. "Readiness fell" is different from "overnight resting heart rate rose." Check the recording period, device fit, charging gaps and any manual edits. If the number is missing, preserve the gap rather than treating it as zero or as a normal result.

Then, add context

Record relevant observations such as travel, a changed routine, an unusual activity or how you felt. Context can suggest a question without proving a cause. Several things often change together. A personal observation that one behavior and one score moved together is not proof that the behavior produced the change.

Prefer comparable observations

Compare the same metric from the same method and a similar setting. If you switch devices or software, note it. Avoid splicing the old and new numbers into an apparently seamless biological trend. A baseline is a reference for that measurement process, not an instruction to stay exactly the same every day.

Choose a proportionate response

If the recording is wrong, correct the record where appropriate. If an unexplained pattern persists or concerns you, bring it to a clinician with symptoms and context. If symptoms are urgent, act on the symptoms. If an isolated wellness score gives no useful information, it may not deserve more of your morning.

A practical record can be brief: date; device and version; metric and unit; collection conditions; symptoms or observations; question for follow-up. The purpose is to improve a conversation, not to build a private diagnostic system from app colors.

The person owns the question

Choose what to notice, what to keep and what to share.

A fictional comparison

Two friends compare their morning dashboards from different wearables. Both see a recovery-like score, but the ingredients and calculations differ. Ranking their readiness from those numbers would create a competition the instruments were not designed to settle. A better conversation asks what each person learned and whether it was useful.

A fictional false reassurance

Another reader feels unwell but sees a good sleep score. The safe lesson is not that scores never help. It is that one summary cannot overrule the person's symptoms. The reverse matters too: a disappointing score alone should not dictate a diagnosis. The device is one source of information, not the final authority.

Privacy belongs in the purchase decision

Before enabling sharing, check what data the app collects, where it is stored, which connected services receive it and how to revoke access or export and delete records. Consider whether location, reproductive-health information or detailed routines are included. Sharing a screenshot can expose more than the number you meant to discuss. Privacy policies differ, so these are questions to check for the product you use.

Usefulness is allowed to be modest

A wearable does not have to predict the future to earn its place. It might help you remember a pattern or frame a better question. It also does not have to be worn all the time to validate your interest in health. If monitoring becomes a source of distress or compulsive checking, discuss that burden and consider whether the feature is serving its purpose.

The optimistic future is not a person permanently supervised by scores. It is a person with clearer information, more agency and room to live beyond the dashboard.

Sleep ECGs and Cardiovascular Risk: Prediction Is Not Prevention

A real research example shows why the evidence ladder matters.

What was studied

Koscova and colleagues studied ECG recordings made from one electrical view of the heart obtained during clinical sleep studies, together with sleep-stage information. The model was further trained using data from 15,809 Massachusetts General Hospital patients and tested on separate groups of 9,810 Emory patients and 12,576 Beth Israel Deaconess patients. Outcomes came from health records. [10]

What the study found

The model's score was linked to later heart and blood-vessel problems and death, even after accounting for several other factors. The pattern was not clear for every outcome. For heart attacks in one of the separate patient groups, the estimate was uncertain enough to include no association. In statistical terms, its confidence interval crossed 1, the value that means no difference for this kind of comparison. [10] This is prediction-model research using clinical sleep-study data, not a trial showing that consumer wearables prevent disease.

What it does not establish

The reported findings do not show that giving people this score improves outcomes, reduces unnecessary testing or produces a favorable balance of benefit and harm. Nor does it validate consumer wearables. The populations referred for sleep studies and the use of diagnosis codes in health records to identify outcomes limit what can be assumed about a general consumer audience. [10]

Why keep it in a Wearables issue?

This work explores a promising idea: existing signals may contain information that has not yet become useful care. A new signal becomes clinically useful only through a credible pathway from measurement to interpretation to an action worth taking.

Sources and further reading

Sources 1-7 describe selected manufacturers' features. They do not show that every wearable offers those features or that using them improves health.

[1] Health-feature overview: manufacturer documentation Feature availability depends on the product.

[2] Overnight health summaries: manufacturer documentation Model and regional limits apply; usual ranges and alerts are specific to this feature.

[3] Activity, recovery and sleep summaries: manufacturer developer documentation Inputs and scoring methods are examples, not universal definitions.

[4] Sleep-stage estimation: manufacturer method description The listed inputs describe this sleep-estimation method.

[5] Readiness contributors: manufacturer documentation The description of a score does not establish health benefit. Time windows and calculations are specific to the feature.

[6] Cardio-fitness estimation: manufacturer documentation The inputs and eligible activities should not be assumed to apply to every wearable.

[7] Skin-temperature deviation: manufacturer documentation Describes skin-temperature changes compared with the wearer’s usual readings.

[8] Schutte-Rodin S et al. Evaluating consumer and clinical sleep technologies: an AASM update. J Clin Sleep Med. 2021;17:2275-2282.

[9] U.S. FDA. Pulse Oximeter Basics. Consumer safety guidance.

[10] Koscova Z et al. Prediction of cardiovascular outcomes using electrocardiography from overnight polysomnography. Sleep. 2026;zsag229. DOI: 10.1093/sleep/zsag229. Research on prediction, not a trial showing that using the score improves care.

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