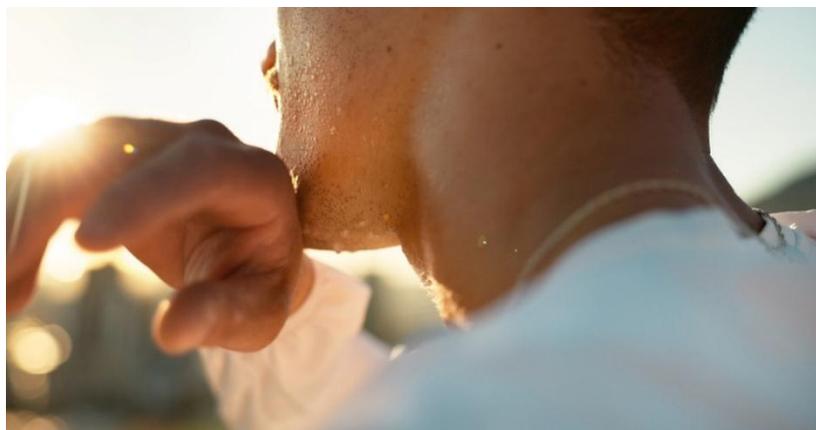


Drug Monitoring and Diabetes Care Transformed by Sweat Testing

A recent review published outlines how sweat can be collected and analyzed for [health insights](#), mapping out the devices, workflows, applications, and gaps that still need to be solved.



Study

Sweat, produced by 2 to 4 million sweat glands, is a clear, slightly acidic fluid that carries electrolytes, metabolites, [proteins](#), and even xenobiotics. Unlike blood tests, sweat sampling is a painless, low-risk procedure suited for repeated or field testing.

Recent advances have coupled microfluidic patches and wireless biosensors with laboratory methods, enabling the detection of interleukins (ILs), glucose, [β-hydroxybutyrate](#), and drugs at trace levels. Beyond clinics, though sweat helps in forensics and monitoring, concentrations are low, volumes vary, and contamination is a real concern.

Further research is needed to standardize the collection, normalize the outputs, and validate the [biomarkers](#), as many sweat-based markers lack clarity in dose-response relationships and clinical validation.

Sweat uniquely combines patient comfort with strong analytical potential. It is easy to access, requires no needles, and can be collected repeatedly during work, training, or daily life. Chemically, sweat carries electrolytes such as sodium (Na^+), potassium (K^+), and chloride (Cl^-), as well as small metabolites including lactate, [glucose](#), and β -hydroxybutyrate, and proteins and lipids in lower abundance.

It can also carry xenobiotics, enabling surveillance of drugs, [alcohol surrogates](#), and environmental toxicants. Because patches can remain on the skin for days, sweat provides a wider detection window than spot urine or finger-prick blood, which is especially useful for longitudinal trends, adherence checks, and field studies. However, variations in gland activity, skin surface contaminants, and sweat rate mean results must be interpreted cautiously and often require normalization.

Findings

Eccrine glands, distributed across most of the skin, and [apocrine glands](#), concentrated in the axillae and other regions, secrete sweat that is slightly acidic and largely aqueous. Molecules reach sweat through passive diffusion from the blood interstitium, active transport via pumps

such as P-glycoprotein (P-gp), receptor-mediated processes, or after local metabolism within gland cells.

Sebaceous secretions mix with sweat on the skin, adding lipids that can carry hydrophobic compounds. Physicochemical properties matter: Small, less protein-bound, and more lipophilic bases tend to partition better. This helps explain why certain [psychoactive drugs](#), pesticide residues, and alcohol metabolites show up in sweat, even when they don't appear in blood or urine. Still, the pathways behind sweat secretion aren't fully understood, and how easily different compounds enter sweat can vary a lot.

The collection has evolved from swabs and capillary coils to integrated systems. The Macroduct system uses pilocarpine iontophoresis to induce local sweating and gathers microliter volumes through tubing. PharmChek adhesive patches accumulate non-volatile analytes over time and include anti-tampering features to maintain the chain of custody. DrugWipe provides rapid, [on-site immunochromatographic screening](#).

Sports-grade microfluidic patches, such as the Gx Sweat Patch, channel sweat through color-changing channels and pair with smartphone apps to estimate sweat rate and [sodium loss](#). Newer dissolvable microneedle patches deliver pilocarpine without the need for external power, thereby improving comfort and feasibility in infants.

Each method trades convenience, volume, and contamination risk differently, so protocols must match the use case, as no collection method is universally suitable across settings. Bench-top platforms extend the capabilities of what wearables cannot yet do. [Nuclear magnetic resonance \(NMR\)](#) enables rapid, non-destructive snapshots of the sweat metabolome.

[Gas chromatography-mass spectrometry \(GC-MS\)](#) remains the gold standard for volatile organic compounds; liquid chromatography-tandem mass spectrometry (LC-MS/MS) and high-resolution mass spectrometry quantify drugs, cytokines, lipids, and small metabolites with high specificity. Capillary electrophoresis-mass spectrometry (CE-MS) excels for the analysis of polar metabolites.

On the discovery side, metabolomics and proteomics reveal disease-linked signatures. Studies have reported sweat differences in atopic dermatitis, [cystic fibrosis \(CF\)](#), tuberculosis, and possible lung cancer markers. These omics readouts inform which biomarkers are robust enough to migrate into next-generation sensors.

Conclusion

This review demonstrates that sweat serves as a credible diagnostic and monitoring matrix when careful sampling, robust preparation, and validated analytics are combined. The authors explain that modern patches, microfluidics, and electrochemical sensors can measure [electrolytes](#), glucose, inflammatory ILs, alcohol markers, and drugs, while laboratory platforms and omics expand discovery and specificity.

They emphasize the advantages of CF testing, diabetes support, forensics, and [public health](#), yet acknowledge the challenges of variability, contamination, and incomplete validation. They conclude that standardized workflows, volume normalization, and prospective studies, combined with Artificial Intelligence-enabled interpretation, are necessary to transition sweat testing from promise to routine clinical and community use.

Source:

<https://www.news-medical.net/news/20251204/Sweat-testing-could-transform-drug-monitoring-and-diabetes-care.aspx>