Focus on wearable sensors

Wearable technologies have the potential to transform our ability to monitor physiology not only in the clinical trial and outpatient settings, but also in the context of health and wellness. These replace monitoring available only in a hospital setting with minimally invasive devices that can be worn and are capable of high-frequency and/or continuous sampling. But only a handful of analytes are known to be faithfully measurable from easily accessible sites, and most of these analytes are relevant to monitoring physical exertion in athletes rather than to broader applications or to disease. Engineers, bioinformaticians, clinicians and biologists are working to develop sensors that access bodily fluids to detect important biomarkers while interfacing seamlessly with skin.

Although wearable biosensors as a whole have not yet been widely successful commercially or been incorporated into clinical decision-making, the promise of measuring analytes such as glucose continuously and non-invasively continue to drive investment, intellectual property (see [Patent Table](#)) and technological development in the field (see [Review](#) by Kim et al.).

People living with diabetes are getting ever closer to having such a device that would free them from frequent and sometimes painful needle pricks. For such a potentially life-and-death situation as type 1 diabetes, though, there's little room for error; the field is rife with near misses. In the meantime, wearable continuous glucose monitors, several of which are in the market today, get partway there, while technology

developers continue to go after accessible fluids, such as sweat, tears and saliva (see [News Feature](#)).

Challenges in sweat and interstitial fluid extraction, microfluidics, sensing, battery life and power consumption are finding answers that will need to be tested in humans and in clinical studies to determine their tractability (see [Review](#) by Kim et al.). They will also need to overcome several economic, technological and cultural challenges in handling data from these devices, including data analysis, management, security and privacy (see [Editorial](#)).

Wearables that access sweat, saliva, tears and interstitial fluid have one major battle in common: to inform on relevant physiology, the analytes they measure must accurately reflect levels in the blood. Many factors, such as food intake, sweat rate, measurement site and analyte transport, determine whether a specific biomarker can and should be measured by these routes (see [Review](#) by Heikenfeld et al.). Studies on large cohorts will aid in making these determinations.

In the past few years, the design of smart-skin devices has rapidly improved as the field of soft electronics has taken off and advances in microfabrication of silicon electronics and e-skin have emerged. Looking ahead, understanding skin homeostasis will be important for interfacing with skin in a manner that allows continuous measurements without irritation (see [Perspective](#) by Someya and Amagai). □

Laura DeFrancesco and Irene Jarchum

Published online: 2 April 2019
<https://doi.org/10.1038/s41587-019-0110-6>

Next month in *Nature Biotechnology*

- A comparison of single-cell trajectory inference methods
- Assembly of long error-prone reads using repeat graphs
- Engineered immune cells as highly sensitive cancer diagnostics