An on-skin device to measure sweat—rate, loss and temperature—in real-time

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The electronic wireless system that softly interfaces to the skin to analyze the dynamics and chemistry of sweat released during physical exertion. Credit: Kwon et al.

Monitoring sweat-related dynamics, such as sweat rate, cumulative sweat loss and sweat temperature over time could help doctors to diagnose

thermoregulatory disorders and other illnesses related to heat stress. However, there are currently no devices that can accurately and continuously measure or estimate these parameters.

Researchers at Northwestern University and Korea Advanced Institute of Science and Technology recently developed an electronic device that can be used to wirelessly measure sweat rate, sweat loss and skin temperature in real-time. This device, presented in a paper published in Nature Electronics, could help to monitor sweat-related dynamics more efficiently and reliably over time.

"We are developing soft microfluidic devices that adhere to the surface of the skin, where they capture, store and perform biomarker analysis of pristine, microliter volumes of sweat as it is released through the action of eccrine glands," John A. Rogers, one of the researchers who carried out the study, told TechXplore. "Our previous research in this area, some of which serves as the foundations for a recently launched commercial product with Gatorade (see Gatorade Gx sweat patch, available on the Gatorade website), relied on the use of visual/image-based determination of the extent of filling of sweat into the microchannel network."

The overall objective of the recent study by Rogers and his colleagues was to develop a digital and wireless platform that could help to track the so-called 'filling process' of sweat without having to visually examine the device. This could be highly valuable for numerous applications, for instance to track sweat-related processes among first responders or health workers, who would generally wear devices under their protective gear.

"The new system we created exploits a non-contact thermal based scheme for tracking the flow of sweat directly from the surface of the skin, in a way that eliminates the need for the microchannel structure entirely but at the same time remains compatible with more complex

microfluidic systems for sampling and biomarker analysis of sweat," Rogers explained. "The device continuously communicates the flow and total volume information to a standard smartphone and also provides information on core body temperature."

The device created by this team of researchers is designed to be applied directly on a user's skin. After it collects sweat-related information, the device automatically sends it to a smart phone via a bluetooth low energy system.

The researchers' sensor can measure the flow of sweat directly and then use the information it collected to quantify total sweat loss, without limitations and without the need for a microchannel structure. Moreover, the device can be combined with advanced microfluidic systems or colorimetric chemical reagents to gather pH measurements and determine the concentration of chloride, creatinine and glucose in a user's sweat.

In the future, the on-skin electronic platform introduced by Rogers and his colleagues could allow health specialists to collect sweat-related information more reliably, in real-time. This could in turn aid the timely diagnosis of numerous disorders and illnesses associated with excessive or dysregulated sweating.

"The wireless, autonomous operation of our system enhances its utility and expands the modes of use to address nearly all applications, from sports/fitness, to worker health, to medical and military uses," Rogers said. "We now are exploring commercialization opportunities, as a complementary or a next generation platform for sweat analytics."

More information: An on-skin platform for wireless monitoring of flow rate, cumulative loss and temperature of sweat in real time. *Nature Electronics*(2021). DOI: 10.1038/s41928-021-00556-2