

NEWS IN FOCUS

EBOLA Brief outbreak reveals gaps in public-health preparedness **p.14**

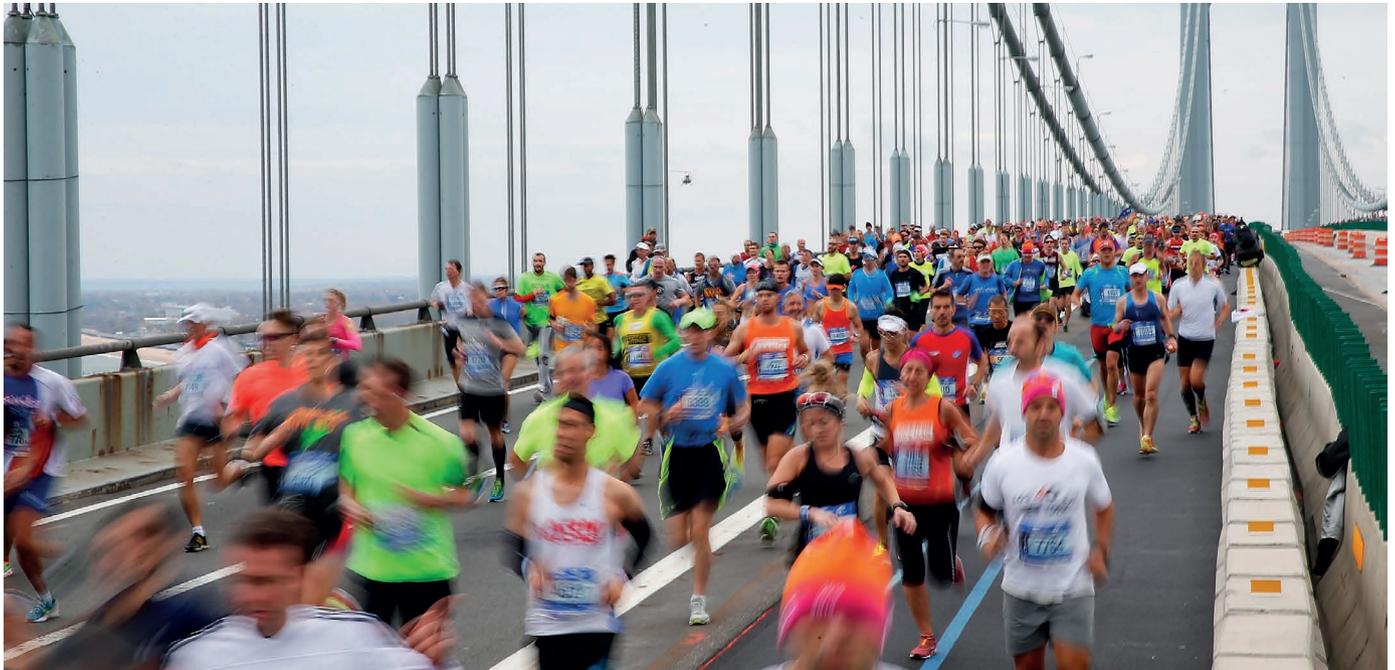
HELIUM SUPPLIES Researchers fear shortage as blockade shuts Qatar refineries **p.16**

FUNDING Report urges doubling of EU's post-2020 science budget **p.17**



CELL LINEAGE Scientists dig deep into the developmental histories of cells **p.19**

MIKE STOBE/GETTY



Researchers are testing whether smart watches and similar devices, currently popular among runners, can be integrated into medicine.

PERSONALIZED MEDICINE

Giant health studies try to tap wearable electronics

Google spin-off explores combining data from smart devices with other health metrics.

BY AMY MAXMEN

On the morning of Tuesday 27 June, a young man walked into an office in northern California, signed a consent form and picked up two devices that will monitor his heartbeat, sleep patterns and a range of other bodily functions. He is one of the first participants in a planned 4-year, 10,000-person study being run by Google's spin-off company Verily Life Sciences, which aims to find out how readings from smart devices can be combined with genetic tests and other data to improve overall health and to predict when someone might suffer a medical emergency such as a stroke or seizure.

Verily's study, Project Baseline, joins a handful of similar experiments, including one led by the US National Institutes of Health (NIH), which enrolled its first person earlier in June and will collect data from wearable devices on some of its one million participants. Together, these studies are part of a broad effort by companies and researchers to take advantage of the data generated by smart electronics.

Today's devices appeal mainly to a select group that wants to quantify the minutiae of their lives, down to how many steps they take while mowing the lawn. But tech proponents foresee a day when sensors linked to smartphones will be an integral part of personalized medicine.

A first step towards that goal will be developing software platforms to integrate the output from sensors with genomic data and conventional medical information. Researchers hope the combination will yield data signatures that can predict diseases and point the way to treatments tailored to each patient.

"Technology is not really the barrier," says Adrian Hernandez, a cardiologist at Duke University in Durham, North Carolina, and a principal investigator on Project Baseline. "What we really need to understand is individual health."

To find indicators of diseases, researchers are taking an approach reminiscent of the Framingham Heart Study, which started ▶

► monitoring about 5,000 adults in Massachusetts in 1948. Over the next few decades, it revealed links between heart disease and high cholesterol, elevated blood pressure and smoking.

In Project Baseline, participants will wear Verily's proprietary Study Watch, which will transmit their heart rate, movements and other information to the company's database. Another sensor below people's mattresses will monitor their sleep patterns. Verily will also collect genomic data, information on participants' feelings (gathered through self-reported surveys), health records, family histories and the results of periodic lab tests on urine, saliva and blood. In-person appointments will mainly take place at clinics at Duke University and at Stanford University in California, which are collaborating on the project.

Jessica Mega, chief medical officer at Verily in South San Francisco, California, says that a key goal is to help the company test and refine its platform for integrating multidimensional health data. "We are building infrastructure that others can use to test hypotheses, tools and technologies," she says.

Verily will make its participants' anonymized data available to researchers from universities and companies on a case-by-case basis. This

may involve companies sponsoring studies that test new technology, says Mega.

The NIH study, called All of Us, received \$230 million in the current fiscal year and is part of the agency's Precision Medicine Initiative. Some participants will have an option to send researchers data collected through smart wristbands, sleep sensors, environmental monitors, genetic and microbiome sequencing and other technologies.

The two massive studies follow smaller ones such as a project led by Stanford genomicist Mike Snyder, who has been collecting more than 250,000 daily measurements from about 100 people in an ongoing project called iPOP (integrated personal omics profiling). In January, Snyder published a paper reporting how sensors he wears clued him in to abnormalities, such as elevated skin temperature and decreased oxygen in his blood, that prompted him to visit a doctor (X. Li *et al.* *PLoS Biol.* 15, e2001402; 2017). The clinician diagnosed him with Lyme disease.

Leroy Hood, co-founder of the Institute for Systems Biology in Seattle, Washington, has

also completed a deep-data study, this one with 108 people. He used lessons from the project to co-found biotechnology company Arivale, which charges \$3,500 per year to evaluate people's data over time from a range of sources, including wearables, genome sequencing and blood biomarkers. Users also repeatedly talk to a coach who looks at the data, and makes recommendations on how to improve their lives.

Some people who sign up for the programme are at risk of diseases such as Parkinson's and Alzheimer's, and Hood says that pharmaceutical companies may be willing to pay for information on these individuals to learn how their chemistry changes if they start to become ill. "This information can indicate biomarkers," he says, "and the idea is that you could then make drugs that would prevent the disease."

One challenge in all these efforts is keeping people engaged over many months. Verily is considering using games to sustain participation. But Hood doubts the long-term efficacy of that approach.

He says Arivale's clients stick with their programme because of the monthly visits to a coach. "It's a lot like therapy," he says, "they become your mother or father." ■

"What we really need to understand is individual health."

PUBLIC HEALTH

Ebola outbreak halted

The virus's emergence in the Democratic Republic of the Congo was brief, but researchers say that it revealed lingering gaps in public-health preparedness.

BY ERIKA CHECK HAYDEN

Epidemiologist Anne Rimoin boarded a flight to Kinshasa on 19 May with a precious cargo in her luggage: the components of a diagnostic test for Ebola.

Rimoin hoped that the test, the GeneXpert Ebola assay, would help officials to track cases in the latest Ebola outbreak, which was declared in the Democratic Republic of the Congo (DRC) on 11 May. The test was developed during the disastrous 2014 Ebola epidemic in West Africa.

The existence of the Ebola assay is a sign that the world's ability to respond to outbreaks of the virus has improved. But the test was not available where it was needed when Ebola erupted in the DRC, says Rimoin, of the University of California, Los Angeles, who has worked with the Congolese Ministry of Health for 15 years. "The fact that I had to go out there with diagnostics in my briefcase is an example of the fact that we're not fully prepared on that score," she says.

On 2 July, the World Health Organization (WHO) declared an end to the DRC outbreak — but public-health officials caution that its low death toll doesn't prove that the world has learnt all the lessons of the West African crisis.



They credit the fact that only four people died to the expertise of Congolese officials, who had dealt with seven previous Ebola outbreaks, and to the remoteness of the northern Bas Uele province where the outbreak occurred.

"The response was good, but it would not be valid to say that this shows that we're ready for a larger response in a bigger context — that remains to be seen," says Daniel Bausch, director of the UK Public Health Rapid Support Team, an agency created to fill some of the gaps exposed by the 2014 crisis.

International agencies sent personnel and equipment in response to the most recent outbreak much faster than they did in 2014, when months of delays allowed the West African epidemic to spiral out of control and eventually claim more than 11,000 lives.

That failure led to calls for drastic improvements in the world's public-health safety net, some of which have been heeded.

A health worker at a Congolese Ebola quarantine unit.

JOHN WESSELS/GETTY