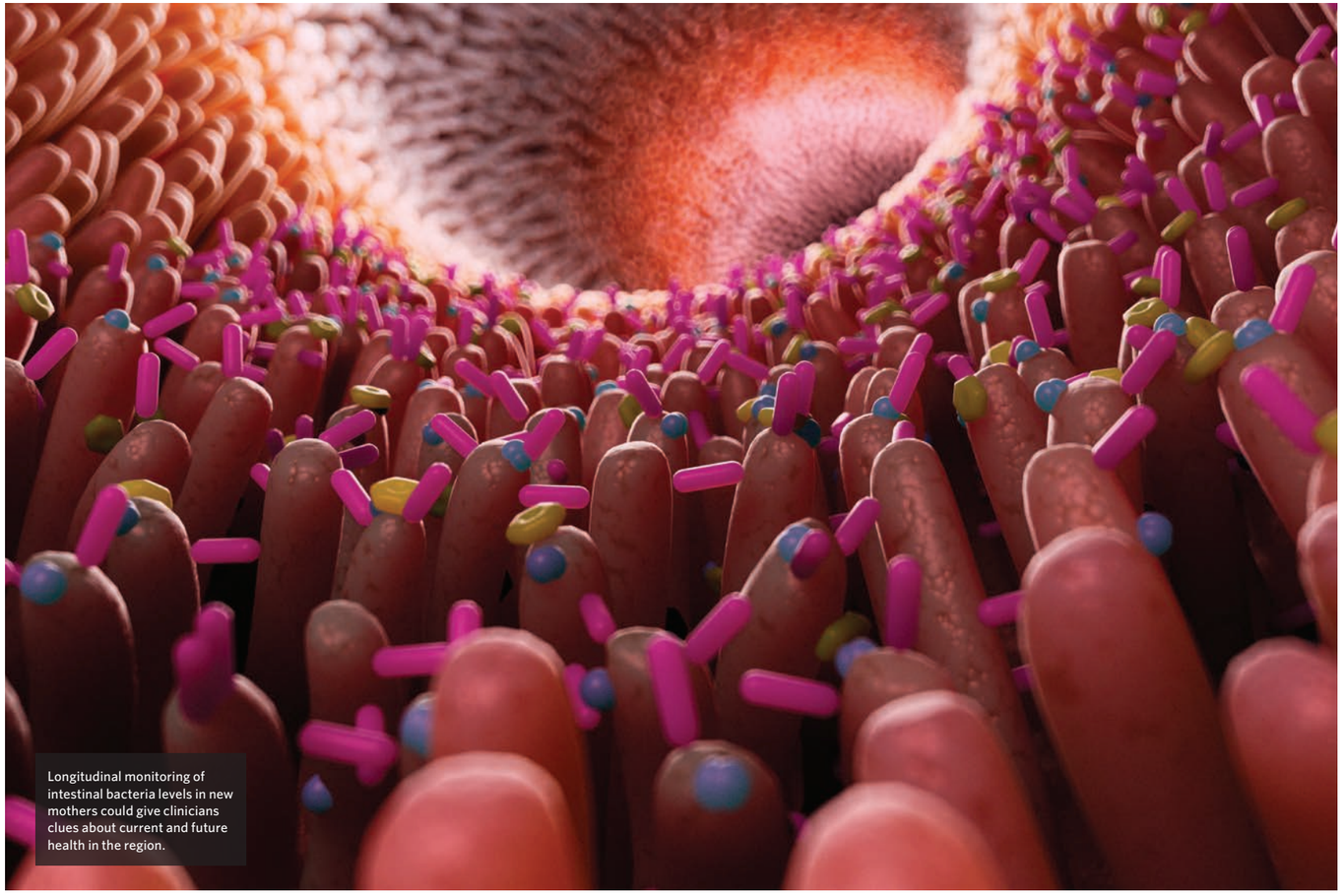
ADVERTISEMENT FEATURE

Quantifiable solutions for communities

Data on social connections is helping researchers FORECAST FUTURE HEALTH NEEDS BY CITY BLOCK, while energy grid modelling and digital innovation promises easy and independent neighbourhoods.



Longitudinal monitoring of intestinal bacteria levels in new mothers could give clinicians clues about current and future health in the region.

Shinji Nishimura is the general manager at the Center for Exploratory Research at Hitachi.

Takashi Takemoto is a deputy laboratory manager at the Hitachi Hokkaido University Laboratory.

After the 2011 Great East Japan Earthquake, analysis revealed that people's feelings about their community affected the rate of a town's recovery. "So we wondered if social capital would also correlate with health status, and indeed it does," explains Shinji Nishimura, who is the general manager at the Center for Exploratory Research at Hitachi.

In a 2018 survey, the Hokkaido University Center of Innovation, which partners with Hitachi, asked 4,250 people in the 80,000-strong city of Iwamizawa in Hokkaido, questions that included whether they normally joined in during local festivals, how affectionate they were to other community members, and whether they had someone living close enough to them to be able to ask for help.

Analysis of the answers, alongside other health data, such as body mass index scores and the number of health insurance claims, conducted by the Hitachi Hokkaido University Laboratory (Hitachi Hokudai Lab) revealed a number of trends. For example, people in areas with high social solidarity tended to have general health checks more often. Obesity rates were also lower in those 65 and older if their community had high social participation rates.

Data on social connection was harnessed using a 'social capital index' – which helps quantify social cohesion, citizen participation and community trust numerically, explains Takashi Takemoto, a deputy laboratory manager at the Hitachi Hokudai Lab. "Real community niceness may not seem possible to evaluate in numbers, but we can do it."

This social capital data is also key to a health forecast system being built for the city. Data based on the index is being mapped alongside medical information that covers 74% of the population in the city of Iwamizawa. This includes health data on hospital visits and medical expenses per capita, and the types of illnesses that are common on each block across the city. The aim is to be able to predict how health trends will change in the coming years.

OBESITY RATES WERE LOWER IF A COMMUNITY HAD HIGH SOCIAL PARTICIPATION

Another aim is to facilitate home-based care and remote medical services, as a lack of doctors is a common issue in fairly rural areas, including in and around Iwamizawa. "People feel that the doctor is too far away, both physically and psychologically," Takemoto explains. "The question then is how much closer we can bring them, both in mind and body, through technologies and services. We hope to develop solutions that help residents feel their doctor's presence by their side."

In addition, Hokkaido's ageing population and declining birth rate are even more alarming than the national average, which is at a record 27.7% of the population and 1.43 births per healthy mother, respectively. "It is said that Hokkaido is where Japan will be in 10 years' time," says Takemoto. "By identifying the challenges in Hokkaido and co-creating new technologies that can help tackle them, we want to create new services that can support the country in future."

Established in 2016, the Hitachi Hokudai Lab aims to create digital solutions to the region's social challenges.

First, they will build a model 'co-living city' in Iwamizawa. The concept proposes a shift from the current administration-governed structure to focusing on independent communities and providing the latest technologies to help groups to support one-another. "The local administration wants to see a concrete example of what a cosy, liveable city looks like," explains Nishimura. "Our co-living model covers various ways to realise that. There should be proper care for pregnant women, children and elderly people, as well as vibrant local agriculture and industry. All of this should be achieved without environmental harm."

HACKING THE GRID

An algorithm that coordinates electric vehicles as they charge at sparsely-located nanogrids across a city could help address Hokkaido's reliance

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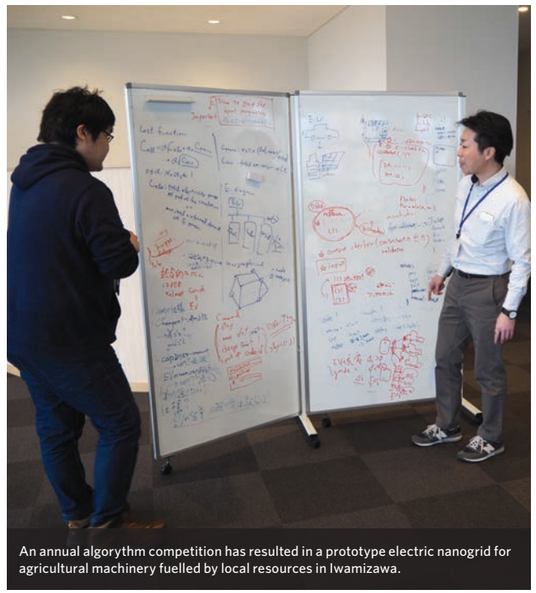
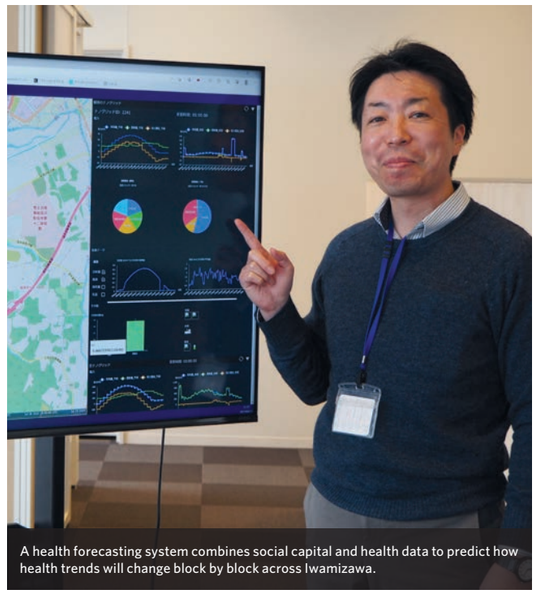


An annual algorythm competition has resulted in a prototype electric nanogrid for agricultural machinery fuelled by local resources in Iwamizawa.



A health forecasting system combines social capital and health data to predict how health trends will change block by block across Iwamizawa.

on the centralised energy network, which currently exposes rural residents to power failure risks during natural disasters. In 2020, an international competition run by the Hitachi Hokudai Lab produced an algorithm that increased independent charging node energy use balance and efficiency by 57%.

The lab is also now building a prototype nanogrid system in Iwamizawa for agricultural uses, based on an algorithm produced by the same contest in a previous year. The system will be powered by solar panels and an engine run off of rapeseed oil and methane produced by a local hot-spring facility. The set-up is intended to help farmers power advanced technology; such as drones that help spray crops. It's a first step towards providing energy support for the agricultural sector in Hokkaido, which is home to the country's largest swathes of cultivated land.

The Hitachi Hokudai Lab contest takes place every year online, and asks contestants from around the world to solve a specific social challenge with an algorithm, which is then put to use. The contest receives hundreds of submissions from people of all demographics.

Nishimura says that this kind of exercise provides great digital simulations of how we could plan society in future. "Factories want to shift to low-carbon energy, but do not know how to do it without disrupting daily operations, for example. We want to show what we need to do and how, with precise numbers, using the power of mathematics and computing."

However, a mathematical solution is not enough to see beyond a community's needs, Takemoto points out. "By operating an actual system, locals will find things we are not seeing now. That will lead to discovering new needs and the start of communication. Together with local citizens, we can find new value in the systems."

THE LOW WEIGHT OF YOUNG MOTHERS IS AMONG THE UNDERLYING CAUSES.

GIVING CHILDREN THE HEALTHIEST START

Early tangible successes have bolstered the lab's case. One of its first focusses had been the health status of mothers and infants. In Japan, nearly one in ten infants weighs less than 2.5 kilograms, and currently Japan has the fourth highest rate of low-weight births in the OECD. The low weight and malnutrition of young Japanese mothers are among the underlying causes.

Health at birth and during infancy can have an impact on the likelihood of the onset of lifestyle diseases, such as heart diseases, stroke and diabetes, later in life.

The Hitachi Hokudai Lab developed a health data integration platform and analysed data including medical records and health surveys, as well as faeces, blood and breastmilk samples from more than 100 women in Iwamizawa, during their pregnancy and after birth. The data was collected as part of a cohort study to investigate how gut flora could be used as an overall health indicator.

The group found that three days after giving birth, levels of *Fusicatenibacter* and *Blautia* bacteria, which are thought to be involved in the immune system, decreased in women's intestinal systems. The study also suggested that a decline in these bacteria might also lead to reduced microbial diversity.

"Our findings showed that intestinal microorganisms might be used to monitor a weakening immune system and other changes to the body throughout pregnancy and after birth," Takemoto says.

By processing and visualizing a complex set of data, the platform allows medical professionals and individuals to monitor their health status and assess which nutrients can help improve it. An intervention that formed part of the study managed to reduce the number of low-weight births in Iwamizawa by almost half, from 11.4% in 2014 to 6.3% in 2019.

"Health projects in Japan often look at healthcare for elderly people," Nishimura points out. "But we think that to create a better society, it's also important to ensure that mothers and children can live healthily and happily."

The lab's database can also help guide local businesses plans for developing new products and services that meet consumers' health needs and help propel the local economy, says Nishimura. "We want to involve many different people in this one set of data. We want to use it to make citizens happy and boost the local economy at the same time."

Thanks to the platform, proposing new disease prevention and care services backed by data evidence will be possible, Takemoto adds. "We are working with local administration in order to return the data to the community through new health policies tailored for them."

NEXT-GENERATION SOLUTIONS

In future the Hitachi Hokudai Lab also hopes to create a space for high school students to virtually build and express their hopes for future cities.

This effort to seek pragmatic solutions from young people was inspired by an ideas marathon organised by the lab with five high schools in Hokkaido last year. The students' direct approach to identifying and tackling social challenges in their school zone deeply impressed the organisers, says Takemoto.

For example, one group proposed creating an app to help elderly people navigate how to use a smart phone in order to close the information gap between generations. "They were trying solve a very important social issue. And they presented a solution that they are able to execute themselves. We really felt the power of these high school students," says Takemoto.

Nishimura adds: "If we want to use their ideas for the co-living city project, we really need to take them seriously." The Hitachi Hokudai Lab hopes that their technologies and community-centred philosophy will pave the way for realizing a sustainable, independent society for Iwamizawa, and Japan.

"To realize a sustainable next-generation society it is very important to find out what makes the city attractive, its hidden needs, and to get the citizens involved," Takemoto says. Nishimura says that he believes "there are other places in the world that share the same issues as Iwamizawa. We want to call out to their people and help solve those issues with our framework". ■

Iwamizawa's nanogrid will be powered by solar and an engine run from rapeseed oil and local hot-spring methane.

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