### HEALTH

# **Game changers**

Medical diagnostics in India is set to witness a boom time as a wide array of easy-to-use and affordable devices are ready for roll-out BANJOT KAUR NEW DELHI



#### SEPTIFLO

Within 15 minutes the instrument can tell if the blood is infected by bacteria or not, and if so, of what kind

HEN HIMANSHU Prasad, 15, caught cough, his parents dismissed it as usual. But his situation worsened and the boy was taken to a hospital near his home in Bihar's Lakhisarai district. The doctor diagnosed normal chest infection and prescribed Levofloxacin, an antibiotic. The drug worked and Himanshu felt better. But the cough returned in a few weeks. The doctor repeated the drug and the boy was once again back on his feet. When the cough came back a third time, the worried parents took him to Patna. The doctor there suspected tuberculosis (TB) and asked for a sputum smear microscopy test. Himanshu not only tested positive for TB, but had also developed multi-drug resistant tuberculosis, or MDR-TB.

Like Himanshu, 21-year-old Anubhav Shastri of Delhi's Vasant Vihar lost crucial time in diagnosis. Six months ago, a doctor at a private clinic gave him antibiotics for recurring fever. When high fever did not subside, he was rushed to a posh hospital in Saket. Here, Anu-bhav's health improved, but only intermittently. Seven days later, he was told to go to a TB hospital. At the National **Respira-tory** Tuberculosis and Research Institute in Mehrauli, his sputum was tested. The result, which came in two days, was negative for TB. The doctor asked for a skin test. That confirmed TB but it took two more days. Anubhav has a TB-infected lump in his chest bone. "Early detection would have saved us a lot of time and money," says his mother.

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and sensitive device that can detect TB and MDR-TB," says ICMR scientist Manjula Singh. TrueNat gives results within an hour while the conventional tests take at least 24 to 48 hours.

TB is diagnosed by detecting the bacteria in sputum sample. For this, over 14,000 designated microscopy centres across the country use the elementary bright-field microscope. World Health Organization (WHO) recommends the advanced fluorescence microscope. These are present in big cities but high infrastructure cost restricts its use. The machine most in use is GeneXpert, which gives better but not hundred per cent result. When the bacterial load is below 10,000 per millilitre of the sample, standard tests can give erroneous results. "TrueNat is so designed that it will not give false results. It is more reliable than any other test for TB," says Singh.

The device is battery-operated and portable. As it is designed for places that do not get regular electricity, it will work well in primary health centres. GeneXpert is useful, but requires uninterrupted power and airconditioning. TrueNat will roll out as part of the Revised National Tuberculosis Programme, a government initiative to make India TB-free. "Its cost is not yet finalised," says Singh.

Valetude Primus Healthcare, a startup led by IIT-Delhi associate professor Ravikrishnan Elangovan, is developing two low-cost and lowmaintenance diagnostic tools. SeeTB will reduce sample analysis time by one-tenth. It will be strapped to the microscopes used in the 14,000 designated microscopy centres. "Once it reaches all the centres, we will amplify its reach," he says.

The startup has also designed a device that can detect typhoid and gastroenteritis. A blood culture for testing typhoid takes 48 to 72 hours. The new machine, called iMC<sup>2</sup>, or



#### IMC<sup>2</sup>

There is no need for trained microbiologists to use this batteryoperated portable machine. It can detect typhoid, gastroenteritis and tuberculosis within six hours. At present, blood culture for typhoid takes 48 to 72 hours



#### **U-SENSE**

A simple change in colour determines the uropathogen that has caused urinary tract infection in a patient. It gives the result in 30 minutes. A standard urine culture takes three days or more for the result

tics. The focus is on making affordable devices that give fast and final results, and can be used at the point of care (patient's bedside). After years of research, the Indian Council of Medical Research (ICMR) is ready to roll out TrueNat, which can remarkably change TB treatment. The innovation can have a big impact on a country often called the global TB capital. In 2016, TB claimed over 480,000 lives in India while more than 2.8 million new cases were registered.

"It is an indigenous, cost-effective

Medical diagnostics take time, are

VIKAS CHOUDHARY / CSE

costly and often give inconclusive results. So many doctors prefer to administer drugs on poor patients on the basis of symptoms rather than recommending expensive tests. The downside is that by the time the disease is diagnosed, patients turn resistant to the drugs that should be treating them, or their disease worsens.

The problem has pushed government bodies, private institutes and startups to undertake massive research and innovate in medical diagnos-

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### **Driving forces**



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"iMC<sup>2</sup> can be used in resourcepoor primary health

### centres that lack infrastructure and trained personnel"

– Ravikrishnan Elangovan, associate professor, IIT-Delhi



"The device that we have developed will be a boon for people in nary tract

### villages where urinary tract infection is common "

- Sachin Dubey, co-founder and chief executive officer, Module Innovations



"Septiflo determines if blood is bacteriainfected. It gives result

### in 10 minutes, and will help doctors in ICUs"

 V Sritharan, head, department of laboratory medicine, Gleneagles Global Hospitals, Hyderabad

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immune-Magnetic cell Capture, will give the result in six hours. It is easy to use, portable, highly automated and does not need sophisticated laboratories or trained microbiologists. "It can be used in resource-poor primary health centres that lack infrastructure and trained personnel," says Elangovan. The two technologies will be in the market in a year or so. "Its cost will be highly competitive and a fraction of the existing tests," he says. Time and cost are critical for diagnostics.

### Tools to tackle drug resistance

Vipin Vashishtha, a doctor in Bijnor, Uttar Pradesh, is unable to understand what ails the two-month-old son of Ram Mohan, who lives in Nizamabad, Bijnor. Almost since birth, the infant has been running high fever. He is also losing weight. Mohan has already spent₹30,000 on visits to doctors and has now admitted the child to a private hospital. "Tests have not given any conclusive result. We do not know which bacteria or fungi has infected the infant," says Vashishtha. Injected with multiple antibiotics, the little one has developed resistance to all major drugs. As his platelet count dips, Vashishtha's guess is that he may have an infection in the brain. The doctor now desperately waits for the urine culture result that may identify the bacteria. But he has to wait for three more days. Till then, the child may be given yet another dose of antibiotics.

Module Innovations, a Pune-based startup, may have the answer to Vashishtha's problem. It has developed U-Sense, a hand-held, credit cardsized device that can give urine test result in 30 minutes. The device has cavities on its four sides. When the sample is placed at the centre of the device, the urine flows to the cavities. A simple change of colour confirms which uropathogen— *Escherichia coli, Staphylococcus aureus, Klebsiella* or *Enterococci*—has

caused urinary tract infection (UTI).

"This will be a boon for people in villages where the number of UTI cases is high. Since it is a point-of-care test, people do not have to travel for it," says Sachin Dubey, co-founder of Module Innovations. It would be affordable too, but will reach the market in about five years, after the startup and the government complete clinical validations in different geographical settings. "At present, we are doing field validation in Pune and Rajasthan hospitals. We will also go to public health centres in Rajasthan," Dubey tells *Down To Earth*.

Module Innovations is one of the three Indian teams to receive £100,000 (₹90 lakh) each for further research on their innovations. The teams will compete for the UK-based Longitude Prize for diagnostic research and innovation in antimicrobial resistance. Biotechnology Industry Research Assistance Council(BIRAC), a non-profit set up by the Ministry of Science and Technology, has given £200,000 towards its fund (see 'Innovators can approach us for finances,' *p*45).

NanoDx, another recipient of the monetary grant, has developed Septiflo, which determines if a blood sample is bacteria-infected. The device, which looks like the one used for pregnancy tests, gives results in 10 minutes through a change of colour. Its viability test is going on at Maulana Azad Medical College, Delhi."The tool will make a big difference in the treatment of ICU patients. The doctor can quickly know which strain of bacteria is causing the infection and can prescribe specific drugs. It will also cater to neonatal infections. This is important because sepsis is considered the second leading cause of death in neonates," says V Sritharan, head of the department of laboratory medicine at Gleneagles Global Hospitals, Hyderabad. The device,

### 'Innovators can approach us for finances'

**MOHAMMAD ASLAM**, managing director of Biotechnology Industry Research Assistance Council (BIRAC), tells *Down To Earth* how the government-aided non-profit hand-holds researchers

### How does BIRAC support research and development in medical diagnostics?

We work in three verticals. We support the researchers in funding, right from the incubation of the idea, to the development of the diagnostic tool, and even in getting through the regulatory processes. We help them in patent filing and technology transfer from the developer to the company for commercialisation purpose. The third vertical is to bring all the stakeholders of innovation on one platform.

Who do you support and how much funding do you provide? From startups to established firms to even government organisations, we support innovative researchers. Individuals who are not registered with a company can also approach us. In 2018-19, BIRAC has devoted ₹40 crore to medical diagnostics

What is your biggest achievement in diagnostic tools? We have worked on conventional tools like TB and antimicrobial resistance to cancer and vector borne diseases. There is a di-



### Does BIRAC also work with international agencies?

Yes. We work in collaboration with UK-based Nesta, Wellcome Trust, USAID and IKP Knowledge Park which support research in di-

agnostics. We collaborate with Nesta in providing the famous Boost Grant. This year, three Indian teams have won the grant.

#### What role does BIRAC see for itself in future diagnostics?

We will direct all our efforts to provide a platform that will converge innovators, academia, research groups, funding organisations and regulatory agencies. We will ensure an ecosystem that would provide suitable infrastructure and facilities at par with any other country so that research and innovation in diagnostics gets a boost.

## expected to be in the market by the year-end, would cost between ₹250 and₹300.

Bengaluru's OmiX Labs and SpotSense have together developed a device to diagnose neonatal sepsis, assess its severity and guide antimicrobial treatment. It is the third team to win the monetary grant. The thermometer-like device tests for the level of biomarkers for sepsis in neonatal saliva and then uses an algorithm to calculate the score. The result can be obtained in 60 minutes. It may be launched early next year.

"Research on a number of pointof-care tests is continuing. These will give results in four to eight hours," says Kamini Walia, scientist at ICMR who is coordinating with researchers developing diagnostic tools for antimicrobial resistance in India. "These will immensely reduce the diagnosis time and check antibiotic abuse."

### For fever-related illnesses

Malaria and dengue are a menace in India. In 2018, malaria claimed 85 lives while over 399,000 cases were reported, shows National Vector Borne Disease Control Programme data. Answering a query in the Rajya Sabha, Minister of State for Health Ashwini Choubey said 101,192 cases of dengue were reported in 2018.

For the timely detection of acute febrile (fever-related) illnesses, Faridabad-based Translational Health Science and Technology Institute is developing hand-held devices to test malaria, dengue and scrub typhus. A drop of blood when placed on the slide attached to the device will give results in 15 minutes. "It is not that point-ofcare tests do not exist, but the new devices will give 70 to 100 times better and cost-effective results," says Gaurav Batra, the professor leading the team of researchers. He hopes the kits will become available in two to five years.

Batra's team is also developing a kit for HIV, hepatitis B and hepatitis C virus on the same model. This would be a 95 per cent improvement on the present lab results, he says. "Many potential patients do not go to hospitals for the test due to the stigma attached with the disease. These tests can be easily done at home," he says.

National Institute of Virology, Pune, has launched a kit for detecting Japanese Encephalitis virus with 98 per cent accuracy. ICMR is developing



### **Detecting funds gap**

The country invests a minuscule percentage of R&D funds for neglected diseases on diagnostics. The world average is slightly better



Source: Global G-Finder report, data sourced from WHO

a user-friendly kit to detect Chandipura virus, the cause of many deaths due to viral attacks in Madhya Pradesh, Andhra Pradesh, Telangana, Bihar, Uttar Pradesh, Gujarat, Maharasthra, Chhattisgarh and Odisha.

To assess if the existing diagnostics are accessible in rural areas, Brookings India Health Monitor conducted a study in 40 primary health centres in three districts—Fatehpur (Uttar Pradesh), Wardha (Maharashtra) and Tumkur (Karnataka). The 2016 study found that tests listed in "essential diagnostic category" were not available in any district. These included tests for TB, malaria, hepatitis B, syphilis and HIV. The study was published in *Lancet* in October last year.

Rural India spends five times less on diagnostics than urban India. Patients in the country annually spend a good ₹21,058 crore on medical diagnostics, shows the health ministry's National Health Accounts— Estimates for India, 2017. This does not include in-patient care.

It is unfortunate that only a minute fraction of government's research and development fund goes in medical diagnostics. Between 2014 and 2017, the country spent a total \$219 million on research in medicines, vaccines and diagnostics of neglected tropical diseases. Of this, only 2.28 per cent was spent on diagnostics, state reports of G-Finder, a comprehensive data source. The global average is only slightly better at 4.58 per cent (see 'Detecting funds gap').

In March 2017, a parliamentary committee report presented in the Lok Sabha flagged the problem. In the 12th Five-Year Plan (2012-17), ₹10,029 crore was allocated for diagnostics. But when the Budget Estimate was made, the amount was reduced to ₹3.575 crore. This was further reduced to ₹3,266 crore in the Revised Estimate. The demand and allocation mismatch has impacted the implementation of schemes of the Department of Health Research, states the report. Soumya Swaminathan, the then head of ICMR, told the committee that the country's budget for diagnostics is meagre compared to that of the National Institute of Health in the US, whose mandate is similar to that of ICMR.

"Government support is crucial but there is little to no fund for researchers at the early stage of their innovation," says an IIT-Delhi researcher who preferred not to be named. "Private funding agencies have largely ignored the development of technologies for healthcare challenges like TB and typhoid in underdeveloped countries. The government should create a central body to fund and promote all innovative projects," he adds.

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(Names of patients have been changed to protect identity)

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