How cellular IoT helps manage public health in Africa during a pandemic

It's a long, dusty road by motorcycle or bus for a courier travelling in countries like Uganda, Papua New Guinea or Mozambique. Strapped across the courier's body is a bag that contains days-to-weeks' worth of handprinted, hard-copy medical diagnostics results. His journey is repeated over and over again, starting at a central lab, out to the remote clinics, and onto the final destination of various governing entities. Health officials need those results urgently in order to identify infected areas and control the spread of deadly infectious diseases.

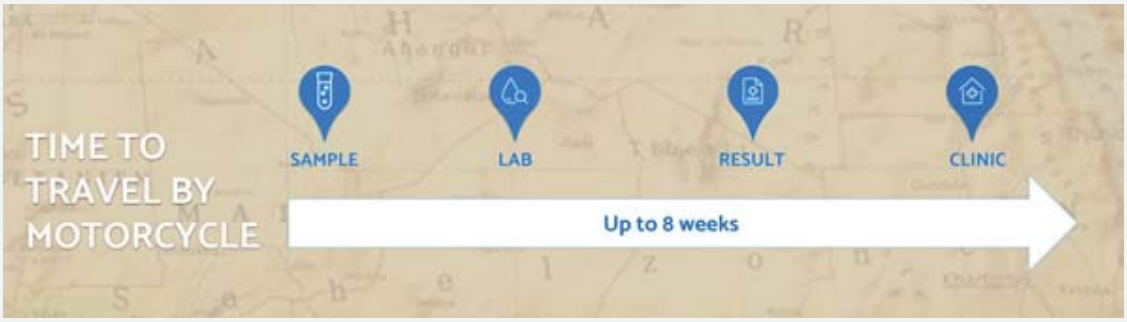
But there's a major problem here: data on paper will never move faster than the spread of diseases. Given the COVID-19 pandemic, this is a recipe for disaster but there is more to the story. This article reports on how low and middle income countries were first challenged by the COVID-19 pandemic, but are now looking to IoT solution company, SystemOne, to manage public health and empower economies by bringing remote diagnostics to the point of care

Source: SystemOne and Twilio

When the pandemic began earlier this year, we witnessed history as doors and borders around the world closed but something special happened in the IoT world. **Twilio** started to see its IoT customers getting creative with how to use IoT-enabled solutions to address the challenges of the pandemic. The Twilio IoT team interviewed a number of subject matter experts and used secondary research to understand more about what was happening with COVID-19 diagnostics and testing with a specific focus on low and middle income countries (LMICs).

The vital role of real-time data

In high income countries like the US or South Korea, well-developed infrastructure means that information travels instantaneously with technology. We can send aggregated reports of COVID-19 test results from San Francisco, California to the White House in a matter of minutes, for example. Countries like Papua New Guinea or Mozambique often lack the infrastructure of real-time communication hence the need for couriers on motorcycles, the hard-copy diagnostics, and delays in accessing data of up to eight weeks. ▶



In the IoT world, we talk a lot about delivering speed and scale

Lack of communications infrastructure

A delay of weeks could have deadly consequences. A recent World Health Organisation reported the progression of the pandemic in LMICs and showed that testing – if deployed in a timely manner – could contribute to saving at least nine million lives and avert at least 1.5 billion COVID-19 infections. Avoiding 1.5 billion COVID-19 infections is comparable to sparing the entire population of the entire continent of Africa. Think back to our motorcycle courier delivering the tests to the labs … then several weeks later, delivering the results back to the original location. Time is wasted, the process is error-prone and some of those tested never even get a result back.

In addition, health officials in LMICs also lack information on infection spread data because of the low rates of testing. In the Congo, there are only 900 daily tests for a population of more than 100 million. Naturally, this raises concerns about the detection and spread of the disease. You've all probably heard in the news that rapid testing is expanding – particularly with the **Bill & Melinda Gates Foundation** that said that it will make 120 million rapid tests available to LMICs over a period of six months. The upside is that these tests provide results in 15-30 minutes and will enable expansion of testing. But again, testing is only one part of solving the problem.

Source: SystemOne

Diagnostic data is stuck in paper form in LMICs

The lack of communications infrastructure in LMICs comes with a lack in digitalisation; many processes are manual, medical records and diagnostics are often handwritten. In the photo above, a local government supervisor in Nigeria copies lab results by hand from a local lab register to a district register. Treating diseases on a national or global level is as much an information problem as it is a medical problem. To take action – and to slow the pandemic, governments must have the communications infrastructure to be able to procure, import, distribute tests and conduct testing, as well as analyse the results and manage the data.

In the IoT world, we talk a lot about delivering speed and scale. And that surely is important for rapid testing. However, it's critical to first turn an analogue paper trail into a digitally processable one. This is exactly where IoT can be transformative. In fact, a natural first step to deploying digital infrastructure could be a cellular IoT solution that can, for example, connect diagnostic instruments in rural areas to report results. Unfortunately, even when the paper trail challenge is solved, LMICs face additional challenges that impact their ability to manage public health during a pandemic.

Healthcare staffing and talent shortages

One research study reported that only 12% of the world's surgical and anaesthesia specialists practice in the world's poorest regions in Africa and Southeast Asia. The astonishing part is that one third of the world's population lives in LMICs – this is where the majority of the world's surgical burden lies.

An ideal COVID-19 response strategy should include early identification, rapid isolation and timely establishment of infection prevention. Furthermore, care for patients with mild symptoms and supportive treatment for those with severe cases of COVID-19 requires trained healthcare professionals. ▶

Imagine trying to manage COVID-19 on top of an already severely constrained medical system. Patients suffer from minimal to no treatment, or they go undiagnosed completely and continue to spread the virus. In order to contain the virus, it's critical to link diagnosis to treatment, also known as care cascade. The problem is that, in LMICs, too many patients get lost to follow-up. Meaning they get diagnosed but never get treatment.

These traffic jams are also disrupting flow of goods, thus increasing operational costs for traders

Thankfully, IoT has the potential to maintain the care cascade. Faster results lead to faster diagnosis. And speed usually results in engagement and keeping people in the health system. Once medical professionals start collecting this information, they can start sharing that information across other systems such as with health officials and governing bodies. That's how IoT helps information turn into action.

Opening borders means opening international economies

Like many counties, LMICs have more than public health to manage during a global pandemic. On one hand, LMICs are tasked with managing a national health crisis for the safety and health of the citizens. On the other hand, LMICs have not been immune to the economic crisis of COVID-19. In fact, they've been hit pretty hard. For example, according to the African Union, Africa is entering its first recession in 25 years, and recent estimates show that COVID-19 could push up to 40 million people in Africa into extreme poverty.

In an attempt to contain the spread of COVID-19 and still keep trade flowing, countries in Africa are initiating testing at the border. The image on the left shows trucks ferrying an extensive variety of exports from South Africa. These trucks are meant to go up north through Zambia, to the Democratic Republic of Congo, Tanzania, Rwanda, Burundi, and up to Kenya. But they are backed up at the Kazungula border. The photo shows a queue of goods. This slows trade and also creates environments where people will congregate - which is exactly what you want to avoid during a pandemic.

To put this into perspective, let's look at the economic value of just one truck that has been delayed. Between August and October of 2020, it is estimated that Kenya has suffered an economic loss of US$200 million due to the delays. This is because a truck which was previously making at least four trips in one month can now only manage one trip because of the delay at the border as traffic stretched about 42 kilometres.

These traffic jams are also disrupting flow of goods, thus increasing operational costs for traders; this causes volumes of perishable goods to go to waste and fuelling corruption cases. Testing at borders does sound like a very logical approach. But these borders are at the edges – with poor communications infrastructure and still only manual reporting capabilities. But it's a great place where cellular IoT can step in and help countries digitise quickly without the expense associated with traditional connectivity solutions. That can help them accelerate economic recovery. It's just really hard to convey the challenges for LMICs. Speed is really the only answer. They need to quickly test and track the results. And without contact tracing, they really haven't solved the bigger problem.

Countries that can allow trade borders to be porous and protected are the ones whose economies will succeed despite COVID-19. They will also be well-prepared for whatever might come next.

Managing public health during pandemics

We know from experience that relying on technology to detect and prevent the spread of infectious diseases can help reduce the number of new infections. The HIV epidemic is a great example of this. According to a United Nations Aids report, there were 1.4 million new HIV infections in sub-Saharan Africa by the end of 2014. Thankfully, beginning in 2010, the World Health Organisation recommended the use of a rapid diagnostic device called the GeneXpert, used for testing HIV and other diseases. But the devices couldn't talk to each other from their distributed locations, making communication about outbreaks difficult. **SystemOne**, a disease diagnostics company, used cellular IoT to send test results to government clinics in real-time. Every diagnostic device in the country was connected to the internet via cellular SIM cards. SystemOne acquired SIM cards from Twilio and ▶

inserted them into smart 2G/3G routers. Once connected, SystemOne rapidly transmitted secure diagnostic data in real-time, see **Figure 1**. They used the power of IoT to send data to a healthcare team and ultimately help West Africa react much faster to control the spread of the disease.

This meant that patients being tested for HIV didn't have to wait three-to-eight weeks for results. Instead, they could hear back within a couple of days, and medical officials could take the right steps to control outbreaks. Real-time diagnostic data decreases the turn-around time for result delivery.

That is huge.

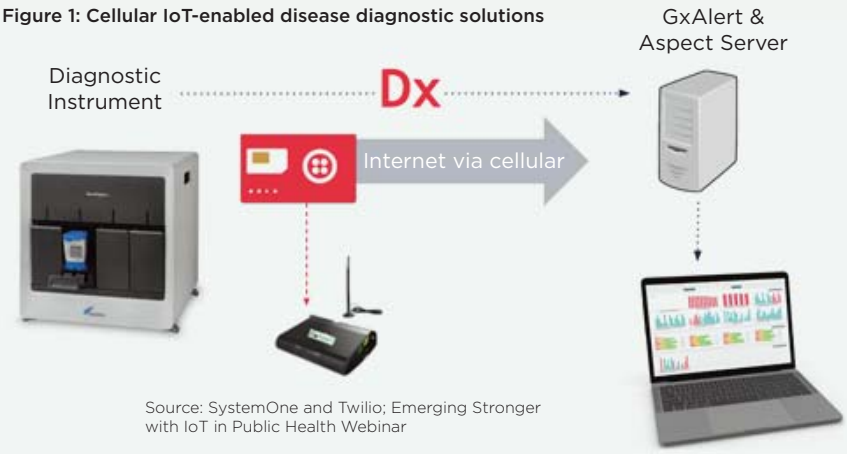
Getting on medication for HIV in one day compared to up to three weeks makes a difference. Getting results faster also keeps patients on the care cascade.

In a published study in the African Journal of Laboratory Medicine, an IoT-enabled solution decreased turnaround time for result delivery by 95% - from 22 days down to <1day - and improved reliability of result return during a trial in Malawi for HIV. In addition, access to digitised diagnostic results introduced real-time accountability. Health and government officials were able to simultaneously know that a test had been conducted and that result-appropriate actions had been taken. Results for rapid reporting through connected solutions are evident in **Figure 2**. Combining cellular connected hardware, communication application programme interfaces (APIs), and software – the typical components of an IoT solution – can result in accessing diagnostic data up in a matter of days.

When history repeats itself, LMICs use IoT to manage public health

The best part is that LMICs can utilise this framework as they work to reduce COVID-19 infection. Using cellular IoT connectivity, solutions like that of SystemOne shorten the time between the test result and the action that needs to be taken. For example, if a patient tests positive for COVID-19, then the action taken would be to quarantine that patient. Both of these details are included in the rapid reporting offered with software. Even more meaningfully, SystemOne was able to share the results with the clinicians using real-time, personalised notifications via SMS or email, including contact tracing information and test result dissemination. This level of engagement with the patient keeps them informed on their diagnosis as well as what action they need to take.

Figure 1: Cellular IoT-enabled disease diagnostic solutions

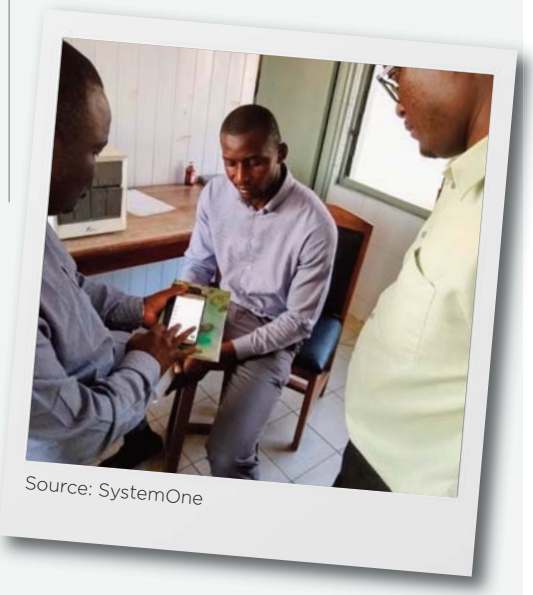


Source: SystemOne and Twilio; Emerging Stronger with IoT in Public Health Webinar

Looking ahead to a brighter future

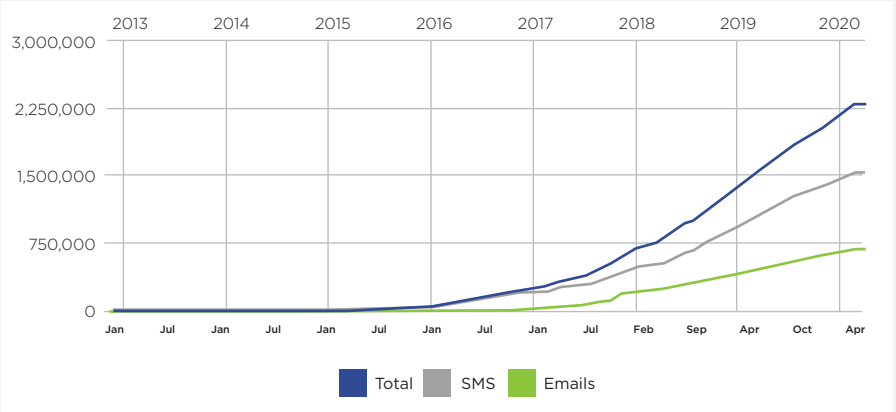
What would happen if every business could find such ingenious ways to incorporate IoT technology into their strategies for the coming year and beyond? If you want to learn more about how IoT solutions can help your business thrive, you can get a more detailed look via Twilio's Emerging Stronger With IoT webinar series. Or, take a look at another webinar, The Unexpected Catalyst of 2020 that Accelerated IoT, where Twilio's IoT experts Elizabeth Grossenbacher and Christine Sunu discuss how the pandemic catalysed IoT deployments for better business outcomes.

Watching the courier continue off in the distance, we can envision a world where instead of paper diagnostics, he can focus on delivering medical supplies and vaccines, which is critical work that couriers are already doing to great effect. By democratising access to rapid and aggregated diagnostic data, this vision could become a reality. ■



Source: SystemOne

Figure 2: Millions of diagnostic results sent with SystemOne's IoT-enabled solution



Source: SystemOne