The DODRES Project

Revolutionizing Human and Animal Disease Surveillance in Tanzania

In August 2015, a cholera outbreak hit Tanzania. What started as a few cases in Dar es Salaam, the country's capital, soon swelled to hundreds. Cholera is spread through contaminated food and drinking water, and without early intervention it can quickly escalate into an epidemic.

The Tanzanian government immediately implemented water sanitation measures and launched health education campaigns to stop the outbreak from spreading. It also began working with the World Health Organization, the US Centers for Disease Control, and other organizations to enhance disease surveillance and coordinate the emergency response. Still, the cases kept coming. By mid-October, there were 4,835 cases in the country. By early December, there were 10,984 cases, with the outbreak extending to 19 of Tanzania's 28 districts.

In March 2016, a Tanzanian government health official recommended that the Ministry of Health contact the Southern African Centre for Infectious Disease Surveillance (SACIDS), a consortium of academic and research institutions working to both modernize and democratize the early detection of epidemic-prone diseases in Tanzania and beyond. The year before, SACIDS, which is headquartered at Tanzania's Sokoine University of Agriculture, had launched a new project dubbed Enhancing Community-Based Disease Outbreak Detection and Response in East and Southern Africa (DODRES), funded by Skoll Global Threats Fund. A primary goal of the project: mobilize local communities to contribute to disease detection and response—and drastically improve the scope and efficiency of infectious disease surveillance in the process.

As it happened, many experts and officials were attributing the persistence of the 2015–16 cholera outbreak to late detection at the community level—precisely the issue that the DODRES project aimed to address. While the tools that the DODRES team had created to support this work were still in beta, the health official had followed their progress and believed that the team had the right skills to solve problems quickly. When the Ministry of Health contacted SACIDS, they asked for help—not just with the response to the present outbreak, but in heading off the next one before it could start.

Quick Highlights

In December 2014, the Skoll Global Threats Fund (SGTF) sponsored an EpiHack™ in Arusha, Tanzania, hosted by the Southern African Centre for Infectious Disease Surveillance (SACIDS). The event drew 66 participants from across sectors and the continent to prototype new tools for One Health disease surveillance in Tanzania.

With a $450,000 grant from SGTF, SACIDS launched the ***Enhancing Community-Based Disease Outbreak Detection and Response in East and Southern Africa (DODRES)*** *project, aimed at creating mobile and participatory surveillance tools that improved traditional disease reporting, enabled community-based reporting, and explored cross-border collaboration in disease surveillance.*

More than 50 people received training on the resulting community-based disease surveillance tools, which were piloted in two Tanzanian districts. In the first five months, 1,915 clinical disease events were reported via the DODRES tools and the spread of several epidemic-prone diseases was halted.

SACIDS is now advocating to integrate the tools into Tanzania's official disease surveillance system to ensure that it captures and addresses critical disease events at the community level. Efforts to deploy the tool regionally are also underway.

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The Idea

In 2014, Esron Karimuribo, a veterinary epidemiologist and professor of medical sciences at Sokoine University and a SACIDS postdoctoral fellow, wrote a proposal to create a new kind of innovation lab. An expert in applying mobile technologies for surveillance of infectious diseases affecting both humans and animals, Karimuribo believed that current disease surveillance systems in Tanzania and throughout the region were ill-equipped to detect and respond to outbreaks in a timely way. But he was equally convinced that these systems could be strengthened.

Karimuribo saw several features of Tanzania's existing disease reporting system—the Integrated Disease Surveillance and Response strategy (IDSR)—as inhibiting stronger disease detection and response:

- IDSR was still largely paper based. Gathering and filing hard-copy reports from across the country was a process inherently prone to errors and significant delays. When Rift Valley fever erupted in Tanzania in 2006, it took nearly five months before the first case was formally reported and the response could begin. Karimuribo believed that digital, mobile surveillance tools, complementing national surveillance efforts, could help accelerate the speed of response and detection.
- As the 2015–16 cholera outbreak would demonstrate, the IDSR had limited ability to detect outbreaks at the village and community levels. Many Tanzanians, especially in more rural areas, favor traditional healers or other local providers over more formal health facilities like hospitals, where official disease data is recorded. "Most preparedness activities in the region are at a high level and not the community level," explained Julius Lutwama, an epidemiologist with Uganda Virus Research Institute and a key member of the DODRES team. "By the time we identify diseases at that higher level, the outbreaks have spread and are more difficult to contain." This problem could be greatly diminished, Karimuribo asserted, by engaging communities to capture and report local events as they occurred—in essence, enabling and empowering them to take ownership and control over local disease surveillance.
- The IDSR was focused only on human diseases, not veterinary diseases, even though roughly 70 percent of human diseases have an animal origin. While the country did have a system for veterinary disease surveillance, it was overstretched, not highly coordinated, and fully disconnected from the human health system. Moreover, none of the country's limited number of livestock field officers were operating at the village level, where most disease events occur. ***The solution, Karimuribo believed, was to promote a "One Health" approach to disease surveillance***—in other words, to track disease events among both humans and animals, as well as other events impacting the health of the environment, in one interconnected system.

While headquartered in Tanzania, SACIDS's ultimate goal was to improve disease surveillance across East and Southern Africa. SACIDS was already deeply connected to other like-minded networks in the region—including the East, Central, and Southern Africa Health Community Secretariat (ECSA-HC), the East Africa Public Health Laboratory Network Project (EAPHLNP), Connecting Organizations for Regional Disease Surveillance (CORDS), and the East Africa Integrated Disease Surveillance Network (EAIDSNet). Karimuribo and his colleagues believed that creating a successful mobile participatory disease surveillance program in Tanzania could, in turn, help accelerate and support the introduction of participatory surveillance tools in neighboring countries as well.

In September 2014, Karimuribo submitted his proposal to Skoll Global Threats Fund (SGTF), pitching the innovation lab as a place where technology tools to address these challenges and opportunities could be created. SGTF offered to sponsor an epidemiology hackathon, or EpiHack™, in Tanzania as a way to begin exploring these ideas. ***"We saw immediately that this project could help test the hypothesis that participatory surveillance is a complement to traditional disease surveillance, and that this could have a big impact in the region,"*** said Jennifer Olsen, manager of SGTF's pandemics practice. SGTF had run similar EpiHacks in Southeast Asia to great effect, but never in Africa, and never to evaluate a One Health approach that combines participatory and traditional surveillance.

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The EpiHack™

The EpiHack™ took place in Arusha, Tanzania, in December 2014. Designed to surface key challenges in local disease surveillance and to prototype new tools and strategies to address them, the five-day event attracted 66 participants—including human and animal health experts, government officials, programmers, and community representatives—from 14 countries and more than 20 local and international organizations. For the SACIDS team, this highly diverse mix of participants represented a rare opportunity. "What had been missing from efforts in the past was the ability for all of these parties to approach an issue collectively and create a targeted plan together," said Karimuribo.

Through presentations and lively group discussions, EpiHack™ participants explored a host of factors that were hindering early detection, timely reporting, and prompt response to disease events in the region. Engaging everyday citizens in capturing these events (in both humans and animals) emerged as a clear priority, as did improving the speed and efficiency of reporting at formal health facilities (e.g., hospitals and clinics).

Participants also highlighted the importance of providing targeted and prompt feedback to the individuals and facilities reporting disease events in the field—something missing from earlier efforts to inspire community participation in disease surveillance—and enabling two-way communication between officials and data collectors. Finally, they agreed that developing the ability to trace specific individuals and animals, as well as their locations, during disease outbreaks (i.e., contact tracing) was another core priority.

Participants then brainstormed how each challenge might be addressed through mobile and digital tools. Working in large and small groups, they white-boarded ideas and even took fieldtrips to local towns and villages to "talk directly to community members and get a feel for the realities and the constraints on the ground," said Eric Beda, SACIDS regional Information and Communication Technologies (ICT) specialist and ICT lead on what would become the DODRES project. Ultimately, participants created four prototypes, one for each priority issue, designing everything from user interfaces to how information would flow back and forth. "We were bringing up ideas and passing them on to the IT people, who were developing things in real time," said Julius Lutwama, who also serves as board chair of EAIDSNet. Added Beda: ***"People got really engaged and excited about working together toward a solution."***

Realizing What's Possible

In August 2015, SGTF approved a $450,000 grant to support development of the EpiHack™ prototypes into mobile technology tools and test them in the field. Once created, the tools would be piloted in select villages within two Tanzanian districts: Morogoro Urban District in southeastern Tanzania, where SACIDS is based; and Ngorongoro District on the country's northern border. Morogoro Urban has 174,278 people and 838,846 livestock; Ngorongoro has 315,866 people and 823,966 livestock. Ngorongoro's border location presented another opportunity. In Africa and elsewhere, cross-border disease outbreaks are not uncommon.

The border between Ngorongoro and neighboring Narok County in Kenya is porous, with pastoralists and their animals migrating seamlessly back and forth. Local officials on each side already exchanged information on disease outbreaks informally. What if shared use of the surveillance tools that the DODRES team developed could both strengthen and formalize their collaboration? Pending Kenyan government approval, the tools could be piloted in Narok County as well. "A lot of countries are trying to think about how to do disease surveillance in places where animals and humans are crossing national boundaries," said Mark Smolinski, director of SGTF's pandemics program. "But this was an opportunity to actually do it."

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Laying the Groundwork

In 2015, the DODRES team began converting the prototypes created through the EpiHack™ into functional tools. From the outset, the tools were built in such a way that they were compatible with the Integrated Disease Surveillance and Response (IDSR) and existing veterinary national surveillance systems. To ensure that the tools were relevant to local needs, the team organized ongoing meetings with community members and district medical and veterinary officers in the pilot districts. SACIDS also worked closely with a range of key partners through each step of the process, drawing on their expertise, their local knowledge, and their local connections.

The resulting AfyaData tools ("Afya" means "health" in Swahili) comprised a simple smartphone app and the infrastructure to support it. Working through a series of screens and prompts, users could record information about possible disease events in their reporting area, upload photos of the affected animal or person if pertinent, and hit "send." That information would then be automatically run through a "smart" database dubbed the One Health Knowledge Repository (OHKR).

afyadata

Filled with coded content related to epidemic-prone diseases and their signs and symptoms, the OHKR helped predict and determine likely diseases based on the details reported. After submitting reports, AfyaData users would receive a fast, automated response advising them of the suspected disease (if any) and how to manage or treat its symptoms. Importantly, AfyaData users would benefit from a different kind of support as well: the ability to engage in real-time communication with officials and health experts by phone or through WhatsApp. Local animal and veterinary health officers, as well as DODRES team members, could also get real-time alerts on their mobile phones whenever new data was submitted. They could log in to the system to see visual maps of reported cases, detailed data on submitted reports, and other key information.

Building a Spirit of Community

A final key piece of the DODRES project was the creation of a community of practice. During the EpiHack™, DODRES team members had noted that strong networked relationships between the ICT developers, health experts, government officials, animal health and human health workers, and community members who attended the event did not yet exist. "If they knew each other it was by happenstance, not by a structure that held them together," explained Olsen. Both SGTF and the DODRES team wanted to create a way to sustain interactions within this group. Said Olsen: "Our question was, How do we engage everyone to be part of an ongoing community of practice that can incubate solutions and keep the work going?"

Before the rollout of the AfyaData tools, a project inception workshop brought many of these participants back together to discuss and refine the DODRES project's implementation plan. Afterward, 46 of the 54 attendees (hailing from 11 countries) volunteered to become members of the TechnoHealth Surveillance group, a digital community of practice. Group members agreed to stay in contact, exchange data and information, and offer real-time support to AfyaData users in the field. Additionally, the DODRES team would publish a monthly TechnoHealth Surveillance newsletter in which members could share experiences, challenges, and solutions related to disease surveillance.

In May 2016, the DODRES team began training users on the AfyaData tools. In total, 53 people received basic training on the tools, the clinical signs of epidemic-prone diseases, and prevention and control measures. With Kenyan government approval of the pilot still pending, no reporters were trained in Narok County. Community health reporters were then given android phones loaded with the AfyaData app, a solar charger, and a first-aid kit. They received referral forms for patients along with training certificates and an introductory letter to present to village leaders in their districts "so that they were welcomed and supported by the community," Karimuribo explained.

Early Outcomes

The AfyaData tool officially launched in August 2016, and it yielded immediate results. In the first six months, a total of 2,069 clinical disease events were reported via the tool. Of those, 1,816 were animal cases and 99 were reports of illness in humans. The vast majority of cases were captured and reported by community health reporters in Ngorongoro District, affirming that community-based reporting can have an outsized impact in rural areas located far from health facilities.

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Among the reported illnesses were many on the DODRES team's list of priority epidemic-prone diseases, including malaria, typhoid, cholera, and rabies in humans and foot and mouth disease and anthrax in livestock. New and unusual diseases were also reported. In Ngorongoro District, reports of a mysterious disease killing massive numbers of goats and sheep turned out to be the result of a mix of two diseases—peste des petits ruminants (PPR) and contagious caprine pleuropneumonia (CCPP)—both on DODRES's priority watch list. One community health reporter identified a case of suspected rabies that turned out to be a rare form of East Coast fever affecting the brain. "These more challenging cases could have contributed to disasters if they had not been reported," said Karimuribo.

Raising Awareness

The DODRES team believes that other potential epidemics may have been averted as well. "Many of these cases would have spread around more, mainly because the illnesses would have gone unreported or because the response would have been late," said Thobias Chacha, a livestock field officer in Morogoro District. Choby Chubwa, a district veterinary officer in Ngorongoro, put the impact of the program in more quantitative terms: ***"Before DODRES, about 30 percent of animal illnesses were being reported into my office. Now we are getting 80 percent."***

The program is also creating greater community awareness of health risks and disease within the pilot districts—another key goal. "It has definitely helped enlighten community members and made them more aware of different illnesses," said community health reporter Francis Meitaya. Fellow reporter Emanuel Labby agreed: "They are becoming more educated and aware of illnesses, and they are learning fast about what medicine is needed to cure or prevent diseases." This is true of illnesses affecting animals and humans alike. "More people identify and respond better to illnesses than ever before," said Elina Gimray, an assistant medical officer in Ngorongoro. She added: "*Everything* works better than before."

Implementation of the DODRES project has not been without challenges. The team experienced significant project delays early on due to difficulties recruiting key project staff, and it took until June 2016 for the government in Kenya's Narok County to sign an official agreement to participate in the DODRES project. "The lesson is that it can take far longer to get the critical pieces in place than you might think," said SGTF's Olsen.

But in other ways, the project has already achieved more by this point in time than initially expected. One early surprise was how quickly the TechnoHealth Surveillance network began operating as a true community of practice. Even before the AfyaData tools launched, members were sharing information and talking about cases in ways that led to the real-time identification of outbreaks. "Through the WhatsApp group, we managed to contain a fast-spreading skin condition among school children that was impetigo-like and was reported by one community health reporter," said Karimuribo. Meanwhile, the group's monthly newsletters, now distributed to more than 600 people, have created a public forum for sharing information about disease surveillance and outbreaks that previously hadn't existed. "Ideally, EpiHacks lead to prototypes that lead to tools," said Olsen. "But the secondary element is that they lead to connections and community, which feels just as important to the success of the broader goal of finding and reporting outbreaks faster."

As hoped, the DODRES team also played a key role in helping rethink national approaches to cholera detection and response. In 2016, at the government's request, the team tested two models of community-based cholera surveillance in areas hardest hit by the 2015–16 epidemic. They also developed new data information flow models that could be used in response to a rapidly spreading outbreak and trained dozens of officials and laboratory technicians on reporting cholera through a modified AfyaData app.

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"We took our underlying phone app and changed what it could be used for," said SACIDS ICT specialist Eric Beda. SACIDS's work has created closer ties between the group and policymakers at the community, district, and national levels. These ties, in turn, are helping to push the larger DODRES project forward.

Looking Ahead

In spring 2017, the AfyaData tools will be piloted in Narok County, Kenya, taking the project across borders for the first time. The SACIDS team is also planning an upgrade to the AfyaData tools and their source code. "We want to make the system faster and simpler," explained Beda. They also want to make it more flexible and dynamic to enable the reporting of a wider range of hazards (e.g., environmental, climate). Meanwhile, the team continues to train more community health reporters and health officials on the AfyaData tools and has near-term plans to expand to cover even more areas within the pilot districts. They are also exploring the logistics of adding laboratory confirmation of reported diseases to the surveillance and response process.

Karimuribo and his colleagues have been meeting with key government stakeholders, advocating that integrating the AfyaData tools into Tanzania's official ISDR surveillance system would help the government fulfill its mandate to improve the efficiency of its disease surveillance and help the country reach its health targets. They have also been building new non-government partnerships in an effort to scale the DODRES project more rapidly—including a new partnership with Amref Health Africa, a CDC-supported organization with unique experience in community-based healthcare and the training of community health workers.

Even as the work to make the DODRES project more entrenched and sustainable continues, the DODRES team, the wider TechnoHealth Surveillance community, and Skoll Global Threat Fund's pandemics team are all eager to support neighboring countries in launching their own community-led, One Health-inspired disease surveillance projects. "Ultimately, we hope to scale and sustain these innovations across more countries in the region," said SGTF's Mark Smolinski.

SACIDS is already designing a five-year project for adapting AfyaData tools in Kenya, Uganda, Malawi, and Botswana, and in February 2017 participated in the development of a joint work plan for cross-border surveillance between Tanzania and Uganda. "You can't just replicate a tool like this," cautioned Smolinski. "You also can't dictate where each individual country will take their tool, because each system has to be relevant to their technology, their culture, their language, and their priority diseases." But he believes that the prospect of a cluster of African countries designing and running complementary community-based disease surveillance program will be worth the effort: ***"When countries start to build on what their neighbors have done, that's when it's going to really get exciting."***

Timeline

Dec 2014	*EpiHack*
Aug 2015	*Project inception workshop; project implementation plan created and TechnoHealth Surveillance Community of Practice formed*
Oct 2015	*Talks with Narok County government officials begin*
Nov 2015	*TechnoHealth Innovative Laboratory established at Morogoro Regional Hospital*
Jan–Feb 2016	*Workshops in Morogoro and Ngorongoro aimed at identifying enabling and constraining factors in animal and human disease surveillance system in the two districts*
March 2016	*Launch of the monthly TechnoHealth Surveillance newsletter*
May 2016	*AfyaData tools training begins*
Aug 2016	*AfyaData tools launch*

Contact

Professor Esron D. Karimuribo
esron.karimuribo@sacids.org

Associate Professor and Head
Department of Medical Sciences

College of Veterinary and Medical Sciences
Sokoine University of Agriculture