

Field survey report

AfyaData Project : Promoting Proper Management of Zoonotic Diseases through e-based One Health Training of Frontline Health Worker

Global South eHealth Observatory
Fondation Pierre Fabre



Community health reporters filling in health forms using the AfyaData application.

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1. CONTEXT

During the five-hour journey from the country's economic capital Dar Es Salaam to Morogoro, the route took us ever deeper into the real rural Tanzania, surrounded with plantations and wild country with zebus and wild sheep.

Agriculture is a very important sector in this country, being the 2nd largest contributor to the GDP (30%) and by far the largest employer, employing over 70% of the active population. Tanzania has the 2nd largest number of animals on the African continent after Ethiopia, in terms of the number of cattle, sheep, goats and chickens.

In addition to breeding, the large number of national parks (17 animal reserves) and the continuation of lifestyles closely linked to the life cycle of the livestock, especially in the Masai Territory, means there is a very high rate of human-animal interaction in this country. Morogoro, the centre of the AfyaData programme, is thus the entry point for Mikumi National Park, much frequented by tourists looking to see the Big Five, but is also the national reference centre for monitoring the problems of "One Health", which links human health with animal health.

According to the WHO, the "One World, One Health" approach (One Health) applies to the design and implementation of programmes, policies, legislations and research works for which several sectors communicate and work together with the aim of improving results in the field of public health. This approach is particularly relevant in the areas of food safety and hygiene and combating zoonotic diseases.

Located in a wide arable plain surrounded by mountains, Morogoro is the capital of a district with the same name, with 2.5 million inhabitants sharing 421 health centres. There are two referral hospitals, including Morogoro hospital with 450 beds, and 52 health centres, with the rest being distributed between public, private or religious clinics.

2. THE TEAM, AND THE INSTITUTIONAL SITUATION OF THE PROJECT

It was in the Morogoro Regional Referral Hospital that the mission first saw the light of day, in the office allocated to the AfyaData team by the SACIDS (*Southern African Centre for Infectious Disease Surveillance*). This regional institution covers 5 countries (DRC, South Africa, Mozambique, Zambia and Tanzania), and was created in 2008 to work against infectious diseases and the *One Health* problems through partnerships formed between medical and veterinary institutions. Apart from the programme that created the AfyaData application, DODRES (*Disease Outbreak Detection and Response in East and Southern Africa*), the SACIDS is also piloting 9 projects (on Rift Valley Fever, breeding in general and molecular biology) in the countries covered, working with teams of experts and medical specialists. Through this administrative and financial supervising authority, AfyaData has been given an office, seconded personnel and an administration and communication department.



StartupBrics with the whole AfyaData team and Dr Filomena Namuba from the SACIDS, in their premises at the Sokoine University of Agriculture.

The team was eager to have me meet their various supervisory teams before getting into the substance of the project, and we then visited the *Sokoine University of Agriculture* (SUA), with 12,000 students and 33 teaching programmes including "Breeding" and "Animal Protection", located near the hospital, and which sends some of its teaching staff on secondment and provides a second office for the project within the University.

The AfyaData team I met thus comprised six people, including two lecturers: Eson Karimuribo, director of the programme, and Calvin Sindatu, epidemiologist, plus a digital specialist, a programmer, a systems analyst and an office manager. Every six months, the team presents its completion report to the National Advisory Board, which in addition to its two supervisory authorities also includes the Ministry of Animal Breeding and the Ministry of Health. The ministry of Health authorised AfyaData to operate as a research project, in accordance with a certificate issued by the National Ethics Committee. Although the project is still at the pilot stage, it still has to submit biannual progress reports to the ministry.

In addition, all interactions of the application are encrypted end-to-end in HTTPS, and all data is the property of the Tanzanian Ministry of Health. This ministry has signed an agreement with the programme to store its data in the future, on its server, as this data is currently still on the SUA university server.

Knowing the various supervisory authorities in the project is in fact important for understanding the basis on which AfyaData was built.

3. HISTORY

According to the Vice-President of the SUA, Professor Raphael Chibunda, *"the programme and its creation were greatly influenced by the Ebola epidemic"*. It was in fact shortly after the Ebola virus outbreak was confirmed by the Pasteur Institute and the WHO in early 2014 that the Arusha international hackathon on epidemics, known as EpiHack, was held. Organised by the SACIDS, it brought together 66 specialists from 14 different countries.

The early stages of the project, then proposed by the DODRES programme, received the

support of the Ending Pandemics Foundation (formerly the Skoll Global Thread Fund) in early 2015 to develop its application, at the height of the Ebola outbreak, and launched it in 2016. The observations made by the specialists at Epihack and used as a basis for developing the various application projects, were as follows:

- The decision-makers in the health industry deplored the severe lack of data at a local level.
- Many inhabitants of countries with low and intermediate incomes, when they fall ill, either do not go to the doctor or they go to a traditional doctor, meaning that they miss out on treatment and their cases are not logged.
- Monitoring is a daily, long-term process.

4. OPERATION AND TARGETS

AfyaData, which means "health data" in Kiswahili, was therefore founded because of the need to identify infectious diseases in the early stages, in order to allow provision of information through collection, analysis and interpretation of data to be used to help with diagnosis and treatment. The application has two principal uses in its current area of coverage: i) daily monitoring of infectious diseases and zoonotic diseases such as brucellosis, rabies and anthrax; ii) early warning in cases of outbreaks (Rift Valley fever, ovine rinderpest, Ebola virus *etc.*).

Professor Karimuribo's teams therefore decided to use digital equipment to collect as comprehensive a set of data as possible and to help them transmit information immediately. To give me a better understanding of the process, the team took me out into the field to see the application working under real conditions.

1) The district health reporters listed the suspected cases

The whole thing starts with Jacob and Zubedee, two of the district health reporters (DHR) trained by AfyaData in the Dumila municipality, which "*comprises 5 villages and exactly 38,083 inhabitants according to the latest census in 2018*", as told to us by the Mayor to whom I was introduced before visiting the village.



The district health reporters need 30 minutes on average to fill in a form and the paper link file which is sent to the clinic.

The application is currently active in six regions in Tanzania: in the Ulanga and Malinyi Districts in the South, Ngara on the Burundian border, Ngorongoro on the Kenyan border, Zanzibar, and in a number of central regions, including the Kilosa District, where the Dumila municipality is located.

Two days a week, Zubeda and Jacob carry out checks in the five villages in Dumila, always following the same route so that no homes are missed. *"We see the people directly, we ask them questions about their health and if we notice symptoms such as fever, trembling or diarrhoea, or if the person is very weak, we fill out the form on the application"*. The application allows photographs to be included in the form, allowing the patient's visible symptoms to be documented. As another important function, the GPS coordinates are automatically linked with the form, allowing the platform to map all the cases.

Therefore, in less than 30 minutes, the patient appears on the application and receives a link file from the reporters, encouraging him or her to visit the nearest clinic in Dumila. They come back a few days later to check that the patient has received the treatment. In answer to my question on how often they report such cases, they advised me that each reporter flashes up an average of two cases per month.



Home page of the application, which offers the options of filling in, editing, deleting, displaying or sending the form. There is also a feedback function (response sent by the platform after the form is sent) and a Health A-Z (literature on each disease).

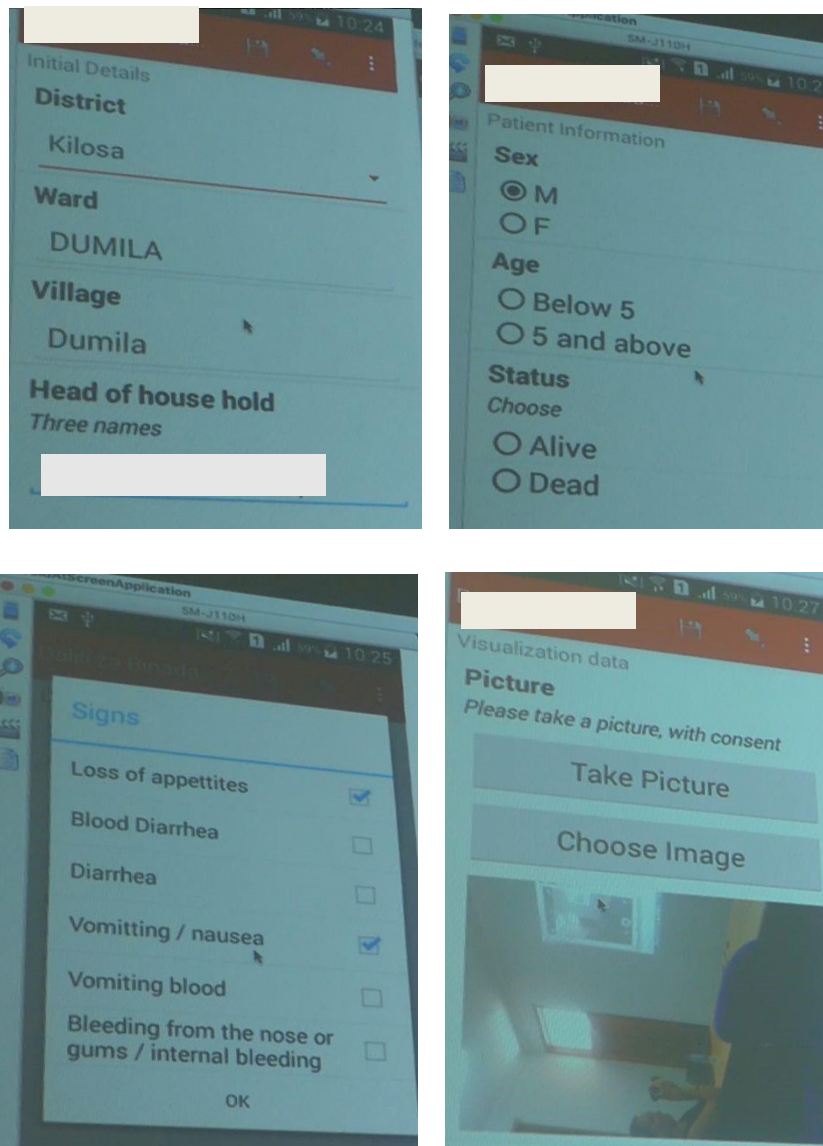
Like Zubeda and Jacob, 114 DHRs were trained in 2018 and AfyaData systematically tries to place one man and one woman in each village. Although the recruits are volunteers, most of whom also work on the farms, the prospect of a smartphone and training in how to use new technologies, as well as the prestige acquired within the community, provides a great incentive for the reporters. After a week of training, they are formally introduced to the residents during a village council meeting.

"Sometimes, you see people who are really very ill and suffering. When the form is filled in and you see that the patient has been treated a few days later, it's very satisfying, that's the reason we continue with the work."

2) The application processes data using an artificial intelligence module

Once it has been filled in, the questionnaire, which contains the patient's basic details (age, sex), symptoms and sometimes an accompanying photograph, is placed on the platform online. Importantly for a country that still has many dead zones, the form is also registered offline; it is put online when the smartphone is next connected.

The symptoms reported will then be compared with the database of the application, which will send comments to the nearest health centre with a list of potential diseases shown in order of probability. The reporter will receive a confirmation that the form has been processed, as well as advice on first aid to be given where applicable.



Different stages of the form to be completed for each case listed.

Professor Karimuribo explained the work that had been done to produce the artificial intelligence module. *"When we worked on the development of the application, a medical research team, consisting of postgraduate students, listed and studied the available literature, as well as the Ministry of Health's directives. They documented each of the infectious diseases frequently encountered in rural Tanzania, and their different symptoms. They also managed to create a reference dictionary."*

The same work has been done on the veterinary side, and rangers in national parts (8) and livestock owners (54) and their vets (78) have been trained in how to use AfyaData. This has led to a double database to which each form completed in the field, for both human and animal patients, is compared.

3) The closest health establishment is informed of the case and receives the patient

My visit followed the route taken by the application and therefore continued on to the Dumila clinic, where the referring doctor, Dorothea Msadala, was waiting for us. Dr Msadala explained that the organisation employed two doctors, including herself, and nine nurses, for an average of about 190 patients received each day. The clinic has no beds, but includes a pharmacy and a laboratory capable of carrying out a variety of tests, including malaria, HIV/AIDS, hepatitis, syphilis etc.



The AfyaData team, the doctor and the district health reporters in front of the Dumila Clinic, which has been funded by USAID and the Rotary Club of Dar Es Salaam.

The doctor examines between 70 and 90 patients a day. She explained that 10-20 patients per month were referred to the clinic by AfyaData. *"I often know that they are going to come even before I receive them; I connect to the app every day and I can see if forms have been filled in."* In actual fact, AfyaData grants its users different rights of access, from the most basic for the DHRs to the most complex for the platform administrators and for regional and national health officials.

Health centre managers, 83 of whom have been trained by the AfyaData teams, therefore have access to the different forms completed in their district. They also receive alerts when the form has been analysed by the platform, with the list of potential diseases. When the patient referenced by AfyaData visits the nearest health centre, he or she gives the link file to the doctor and is treated the same way as any other patient, but with the information from the online form and the epidemiological probability statement produced by the platform too. This, in fact, is a diagnostic aid.

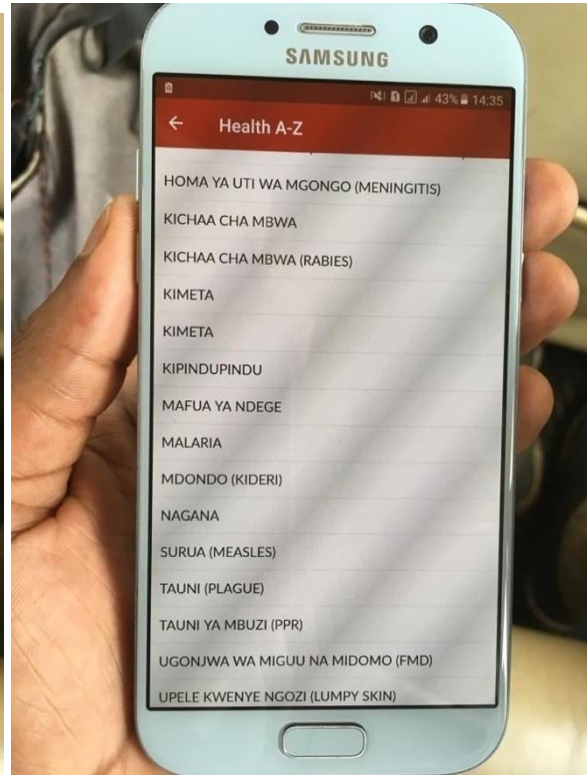
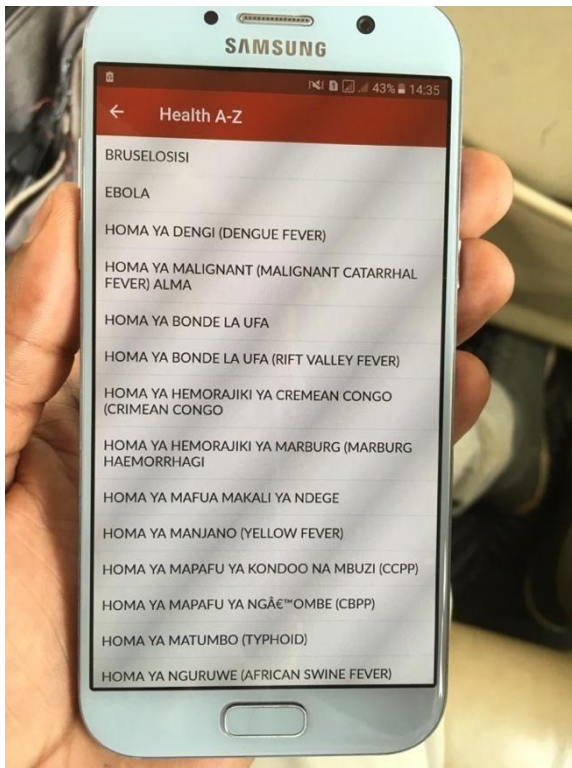
"Once they've given me their file, and using what I've read on the application, I examine them and carry out my additional survey. If I think there could be a zoonotic disease, I obtain more information: the area in which the patient lives, for example, or their lifestyle. Afterwards, if [malaria] is eliminated after a negative test and there is consistency with the probability of brucellosis or rabies as defined by the application, I then prescribe first-line medicines and refer the patient to the next health care level", the doctor explained.



Dr Msadala examining a patient.

Professor Karimuribo explains that the clinics do not have the technical resources for detecting zoonotic diseases, which are however very common in the area concerned. *"The health staff in the nearby centres have not been trained to detect these diseases; they do not have the protocol. Most frequently, when they find symptoms of brucellosis, for example, one of the most frequently encountered diseases here, with fever, headaches and weakness, they conclude that it's malaria or typhoid and prescribe accordingly, while the patients come back two or three weeks later, when they're told to come back, with exactly the same symptoms."*

AfyaData has therefore introduced a "first aid kit" into its application, in the form of *Health A-Z*, which allows health centre managers to consult the available literature for each disease. Specifically, it is this area of the project that the team wants to develop in future.



← Health A-Z > Brucellosis

BRUCELLOSIS

What is brucellosis and its causes.

Brucellosis an important zoonotic bacterial disease that causes significant reproductive losses in animals. The disease is caused by members of the genus Brucella, usually by Brucella abortus in cattle, B. melitensis or B. ovis in small ruminants, B. suis in pigs and B. canis in dogs

Can I get brucellosis?

Yes, bacteria causing the disease can infect humans. Usually by ingesting organisms or by the contamination of mucous membranes and abraded skin. In the laboratory and probably in abattoirs, Brucella can be transmitted in aerosols. Common sources of infection for people include contact with animal abortion products; ingestion of unpasteurized dairy products from cows, small ruminants or camels; ingestion of undercooked meat, bone marrow or other uncooked meat products; contact with laboratory cultures and tissue samples; and accidental injection of live brucellosis vaccines.

How can I protect my animals from brucellosis?

Perchance animals from accredited brucellosis free farm, animals from other herds should be, isolated and tested before adding to the herd. Vaccinate your animals as vaccines against B.abortus and B. melitensis are commercially available.

How can I protect myself from brucellosis?

Avoid eating undercooked meat. milk should be

← Health A-Z > Rabies

RABIES

What is rabies?

Is a viral fatal zoonotic disease that occurs worldwide and affect a wide range of domestic and wild mammals and humans. The disease is endemic in most of the developing countries hence higher incidences of the disease in these countries. The disease affects the central nervous system of the diseased animal and the animals that are already showing signs always end in death.

How is the disease transmitted?

The disease is transmitted by direct contact with the infective materials from the diseased animals including saliva and spinal fluid. Therefore bite from diseased animal is the most considered way of transmission among animals and animal to humans.

Which animals are at risk of getting the disease?

All mammals can get rabies when exposed but the level of susceptibility varies between animals. Most cases in domestic animals species occur in cats, dogs, cattle, and horses; less commonly cases have occurred in guinea pigs, rabbits and a miniature pig. In wildlife, raccoons, skunks, mongoose, and bats are major reservoirs.

Can I get rabies?

Yes, humans can get rabies when bitten by the rabid dog or when saliva from the infected animal penetrates the skin especially where an individual has broken skin. The symptoms in human will be observed in 1 to 3 months after being exposed, and the signs will include

List of diseases described in the "Health A-Z" tab. By clicking on it, the doctor can access the literature for each particular disease. Example for brucellosis and rabies.

4) Morogoro Hospital, the last resort

The doctor advised me that she refers an average of two patients a month to the higher level for suspected zoonotic disease. In this area the Kilosa District Health Centre will refer patients to the Morogoro Hospital themselves, the only place that can screen for this type of infectious disease.

This long-drawn-out procedure can take several months, with patients often losing heart in the meantime because of lack of time or money. For this reason, AfyaData wishes to work at local level and increase doctors' training and ability to treat these patients in future.

In Morogoro I met with the Ministry's regional health manager, Professor Franck Jacob. For him, the AfyaData programme most certainly has added value. He shares with me an experience he had in his last job, when working as health manager for the Ulanga District (in the Morogoro Region). *"One of my postgraduate students was doing her thesis on brucellosis. The tests that she carried out showed a 90% incidence of this disease in the patients in the hospital! However, her study also highlighted the fact that the medical staff were not trained in the diagnosis or treatment of brucellosis. This meant that most of the time they were being prescribed large quantities of antibiotics, when this was certainly not the right treatment."*

Community Health Reporters Form List

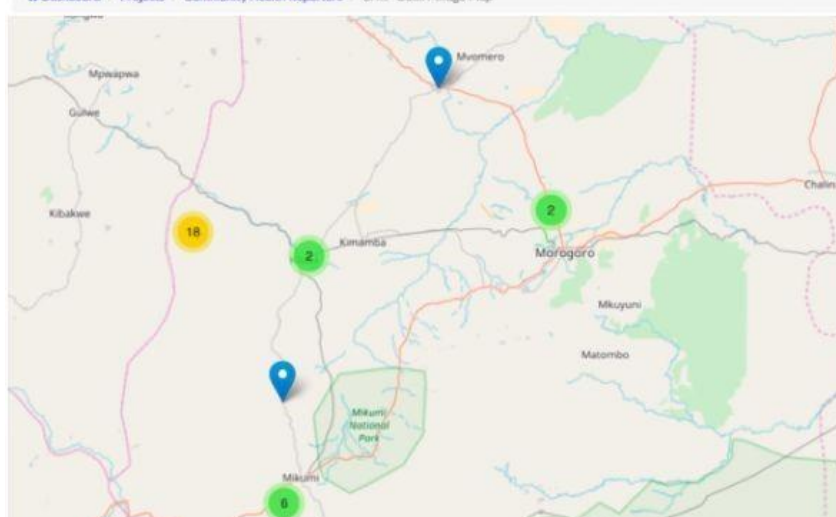
Dashboard / Projects / Community Health Reporters Forms List

+ Add New Form Edit Project Enter Form Name

| | Form name | Sent Forms | Access | Created on |
|---|--|------------|---------|---------------------|
| 1 | CHR - Dalili Binadamu CHR Dalili Binadamu - form to report human based disease symptoms in Kilosa, Ulanga | 1038 | Private | 18-02-2018 11:22:29 |
| 2 | CHR - Dalili Mifugo CHR Dalili Binadamu - form to report animal-based disease symptoms in Kilosa, Ulanga | 370 | Private | 18-02-2018 11:55:29 |
| 3 | Usafi Jamii | 250 | Private | 26-04-2018 12:53:39 |
| 4 | Afya Taarifa Form to report human health events | 22 | Private | 21-05-2018 11:25:49 |

Community Health Reporters : CHR - Dalili Mifugo Map

Dashboard / Projects / Community Health Reporters / CHR - Dalili Mifugo Map



The map displays the region around Morogoro, Tanzania, with various health centres marked by colored circles and pins. The markers are labeled with numbers: 1B (yellow), 2 (green), 3 (blue), and 5 (green). The map shows roads, rivers, and geographical features like hills and forests. The city of Morogoro is clearly visible in the center-right of the map.

The health authorities have access to an overall view of the forms filled in by the health centres and of the map, on which they can zoom until they find the one form.

At supervisory level, the application also has a web version for health decision-makers, which allows access to all the cumulative statistics for forms filled in since the initiative started in 2016. These four years of data are displayed visually and the browser allows detailed analysis of information entered, down to single form level. A triage module helps select the relevant information according to certain chosen criteria (cases per region or locality, or cases of each disease, for example). Geographical display of data is also possible, listing cases on a "zoomable" map. New diseases can also be added, and their symptoms documented.

5. IMPACT AND ADDED VALUE

The first added value acknowledged by all the actors that I was able to question is the ability to collect and transmit data. For Professor Raphael Chibunda, Vice-President of the SUA, *"AfyaData facilitates the reliable and very fast transmission of data from the field to the centres where the decisions are taken."* On the date of the programme's official implementation, the district advisers and their health managers thus came to testify to the importance of the application, he advised. *"There can no effective public policy planning without reliable data from the field "*, concluded the professor.

From the reporters' point of view, AfyaData saves significant amounts of time compared with the paper processes, and also speeds up the process of transmission and of alerting the responsible authorities. This is also the opinion of those who make use of the data, and Professor Jacob, the regional health manager, explained that his ministry has launched a programme to digitise certain forms using tablets within the referral hospitals: *" In our eyes, success in simplifying the collection of information is essential, and AfyaData is a great addition to our programme. The ministry and its various departments find it very difficult to obtain reliable data, especially at a local level."*

Another function of the application is an instantaneous messaging module, which allows health managers to interact directly with district health reporters or doctors, and ask for additional information or verification, explained the SACIDS manager, Dr Filomena Namuba: *"It's very useful, especially in remote areas, and with its ability to take photos, this is becoming a very valuable telemedicine tool ."*

The second added value of the programme is the improved care of patients at local level.

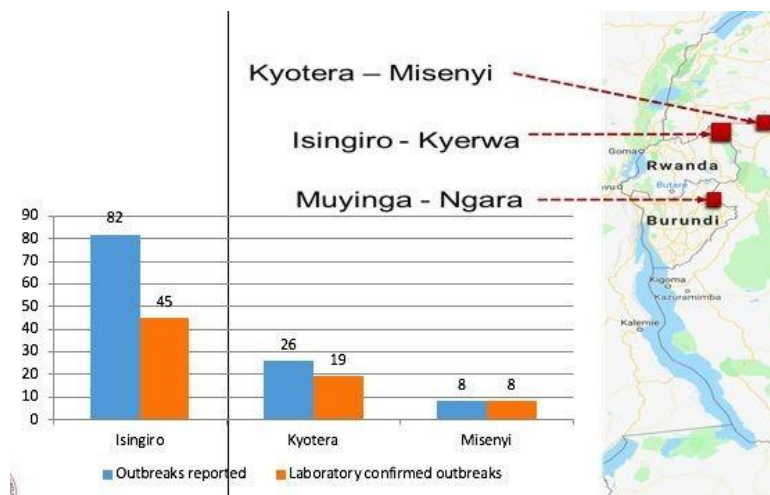
As well as simply registering the cases, the communal function of AfyaData allows patients to be referred to the conventional health system: *"Before this was introduced, the patients did not necessarily go to the clinic, or else they went to the local pharmacies. Now, they realise that they can find a cure by going there, and that we're there to follow them up afterwards. They can see the point of travelling to the pharmacy and getting the right treatment there"*, Zubeda declared, a health reporter from the Dumila District.

This cultivation of awareness in and by the community is further strengthened by the WhatsApp groups set up by AfyaData. Eric Beda, an engineer and the team's digital expert, explained that there is no restriction of access to this tool: every user of the application (DHRs, health centre managers, health officials and decision makers) is in a group. *"WhatsApp allows them to help each other when they have problems, or to talk about the subject and circulate information. This tool allows them to create a community and increase the level of attention*

paid to the subject, as well as increasing awareness of the care community." Groups are created for each locality, with the Morogoro group counting 150 members.

Finally, the programme is an effective tool for early detection of epidemics. The sending of real-time data from the field, coupled with the ability of doctors to counter-verify, has already helped AfyaData to stamp out several incipient epidemics. Professor Karimuribo thus proudly gave a list of their success stories: "The platform revealed an outbreak of a mysterious disease in Korombo, something that killed over 1,000 head of livestock. With the help of the AfyaData teams, we succeeded in identifying a mixed outbreak of ovine rinderpest and contagious caprine pleuropneumonia (CCPP). Elsewhere in our districts, we have helped contain an outbreak of something similar to impetigo, which was affecting school students. On another occasion, the application detected an epidemic that was affecting cattle and sending them mad. Contrary to initial analyses, the system revealed that this was not an outbreak of rabies but of East Coast Fever, a disease unique to East Africa." The doctor's teams added further to this list, with the same level of pride, mentioning a case of some monkeys that had started attacking cattle, the containment of a rabies epidemic in the Ulanga province, and the death blow dealt to an outbreak of anthrax in Ngorongoro.

EPIDEMIC CONFIRMATION AND TRACING



Study conducted by AfyaData in 2018 to establish the success rate in tracing epidemics with application in three border districts.

This already impressive list of results for such a new programme appears to have convinced numerous regional health actors, and the AfyaData team is now in discussions with several organisations with a view to extending part or all of its application to other types of infectious disease and other geographical areas.

The team was thus called to the Democratic Republic of the Congo at the end of the Ebola virus epidemic, where it trained trainers and set up a surveillance committee. The Food and Agriculture Organisation of the United Nations (FAO) has also contacted them with a view to working on a tool dedicated to animal health. The project has been preselected by the CDC to form part of a surveillance programme for African Union events covering 55 countries. The Community of East African States has also shown some interest.

The programme has also been included in a number of international medical cooperation networks via SACIDS, including CODS (*Connecting Organisations for Disease Surveillance*), an

exchange network for infectious diseases. One of CODS's South Asian members, MBDS (*Methane Based Disease Surveillance*) has called on AfyaData to develop a dedicated version of the application on the basis of its cross-border field information schedule.

6. ECONOMIC MODEL AND FUNDS RECEIVED

AfyaData has been developed on Android in open source. The multilingual application can therefore be downloaded from PlayStore by everyone wishing to use it in "black hole" areas. The digital expert says: *"Use of the application is free of charge, and always will be. We simply ask the organisations who want us to develop certain dedicated functions to pay us for our time, like MBDS, but that's all."*

The project is therefore 100% dependent on grants, which have been paid in full since the beginning by the *Ending Pandemics* organisation, in two instalments of \$450,000 followed by a third payment of \$234,000. The costs of the programme, estimated at \$220,000 per year, relate to the smartphones allocated to each user, the cost of training (travel, food and drink over each week-long course) and compilation of progress reports, which involve travel by the whole team and a number of officials to the field. The team members' salaries are currently paid half by SACIDS and half by the SUA.

The team is also in discussion with national telephone operators to see how they could subsidise part of the telecommunication costs and thus make the process completely free for the users (principally via telephone credits).

CONCLUSION

By relying on the community and local networks for setting up its infectious disease monitoring network, AfyaData has developed an application that works very close to the ground, while mastering the digital tools than can connect it instantly to the medical authorities in the country. The integrated approach of Professor Karimuribo's teams is welcomed by the authorities, for whom collection of reliable data in their respective regions and districts is crucial.

The development of this application in conjunction with the various authorities on the one hand and the end users on the other hand has allowed its use to become very familiar very quickly, and has led to the creation of a real community in the fight against infectious diseases, with more and more patients coming into the conventional health system.

These advantages have made this tool very valuable in the fight against epidemics such as Ebola, Rift Valley fever and anthrax, and its use is currently being planned by numerous international organisations such as the FAO, the CDC, the African Union, and Community of West African States as well as South Asia's MBDS.

AfyaData is also a simple system used daily in the monitoring of infectious diseases affecting the communities of rural Tanzania. Developed using the *One Health* approach, the programme is currently aiming to strengthen the training of health staff in the diagnosis and treatment of zoonotic diseases, the spread of which is currently underestimated. This aim involves

developing communication supports on the one hand and making scientific material available to combat these diseases on the other hand.