

Technological solutions for building effective global health surveillance systems

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Introduction

One of the main objectives of health surveillance systems is to support the development of health prevention measures.

Such surveillance systems are rare in Africa. There are significant needs to monitor and anticipate the many epidemics emerging in isolated and marginal regions. The use of innovative technologies to develop surveillance systems adapted to Southern countries is a major issue.

Using mobile technologies for public health purposes (mhealth), it is possible to collect data and monitor health phenomena in time and space. Such technologies rely on the availability of a far-reaching telephone network and free digital platforms that enable simple, rapid, and accessible implementation of a geo-referenced health surveillance system.

Background

As part of the **Equity in Health** research program in Burkina Faso, we developed two georeferenced surveillance systems. One was focused on road accidents and trauma events, and the other on dengue. We constructed a tool that provides geolocation of cases using mobile telephone technology.

Dengue:

In September 2013, the general population, health professionals, and the media were all concerned about the presence of the dengue virus. Very little up-to-date and detailed information was available.

One of our studies demonstrated that three serotypes were circulating in Burkina Faso. This meant that this disease, ignored up to that point, had to be taken more seriously and that surveillance was required, not only for dengue cases but also for the presence of vectors.

Trauma:

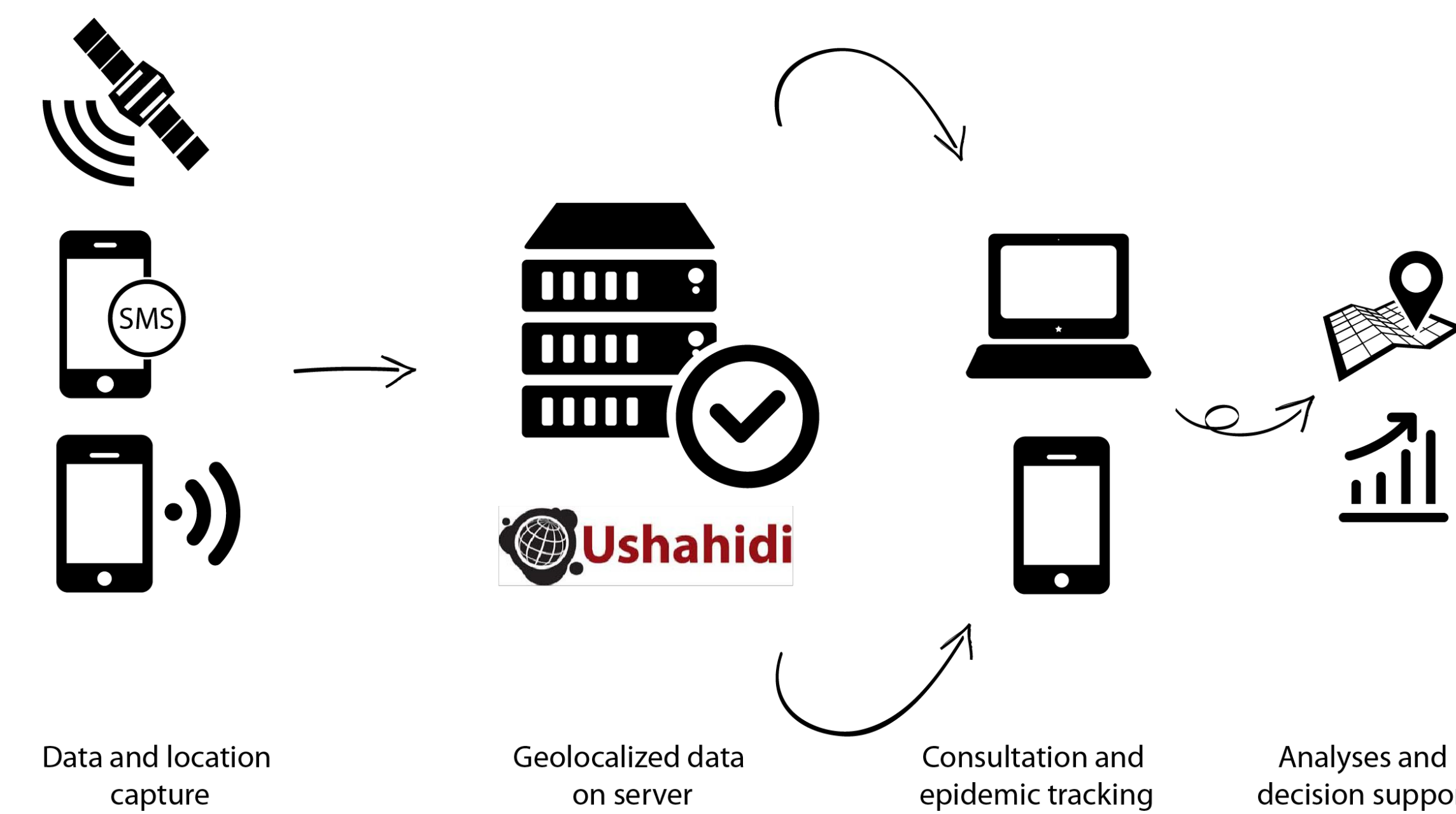
Traffic accidents have become a public health issue worldwide. In Africa, traffic accidents are the fifth leading cause of mortality (WHO, 2015)

Ouagadougou is greatly afflicted by this public health burden. The number of traffic accidents involving trauma is rising every year, but without a reliable data collection system it is difficult to estimate morbidity and mortality.

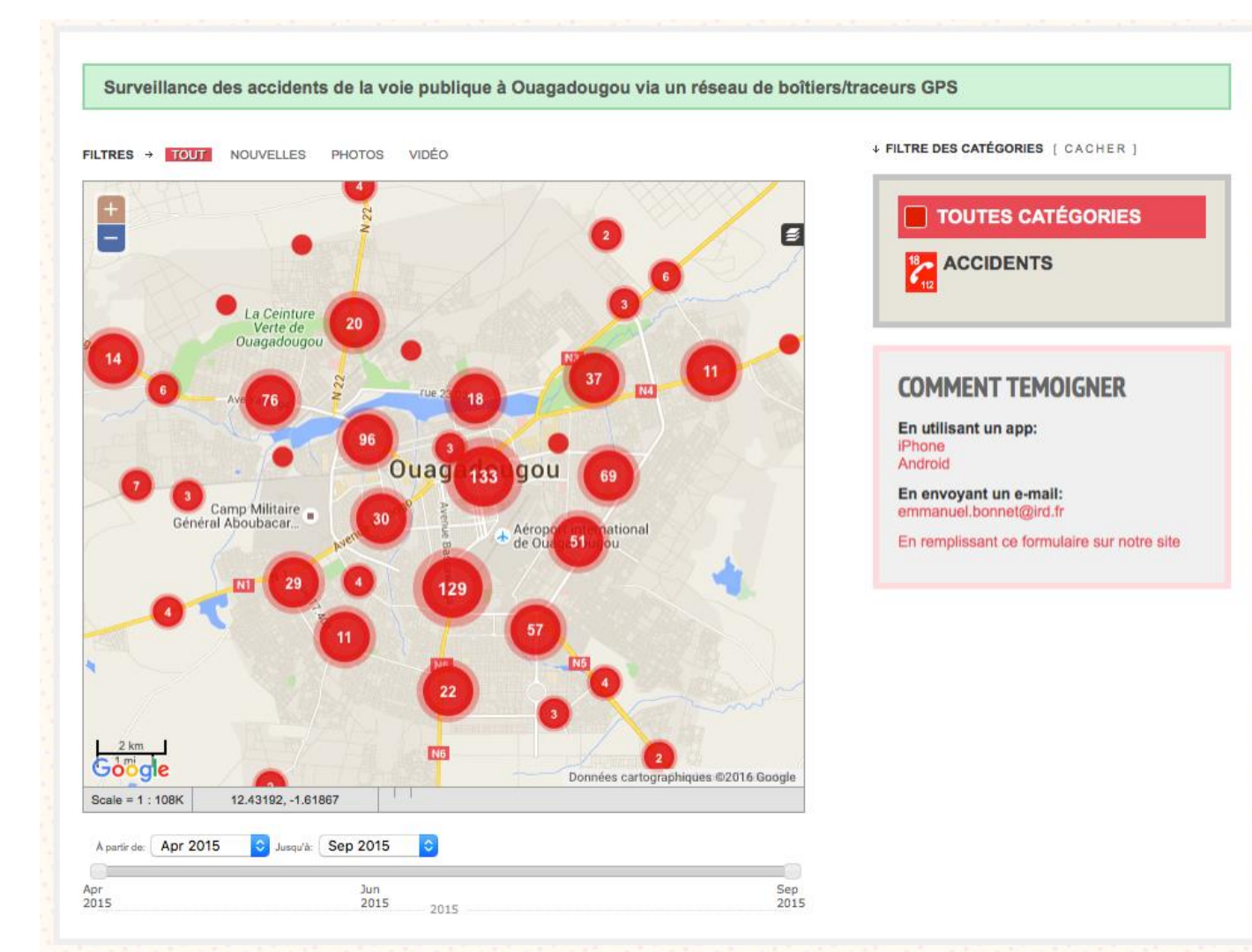
Materials and methods

We implemented a tool for epidemic surveillance and spatial-temporal monitoring which we developed using Ushahidi, an open-source tool that applies the crowdsourcing concept to mapping and geographic information. Ushahidi (“witness” in Swahili) uses SwiftRiver, a free open-source platform that allows information to be extracted very rapidly and then restored after being filtered and verified. The sources include a variety of channels such as Twitter, SMS, email, and RSS.

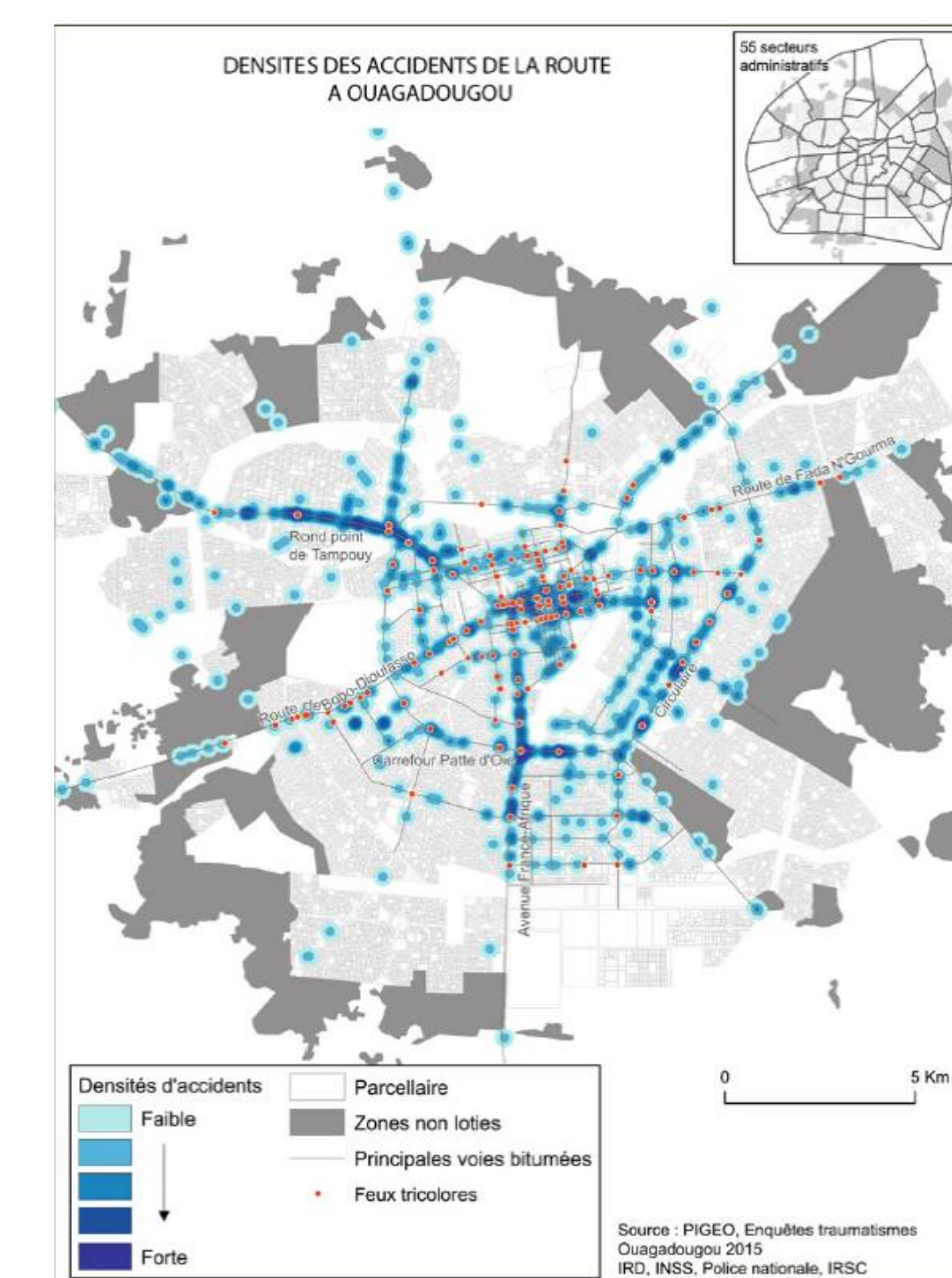
The dengue and trauma surveillance platforms were developed with Ushahidi using SMS and 3G data transmission. Data are sent to the platforms in real time, integrated into the Ushahidi interface, and then mapped. The platforms are accessible via Internet.



Trauma surveillance



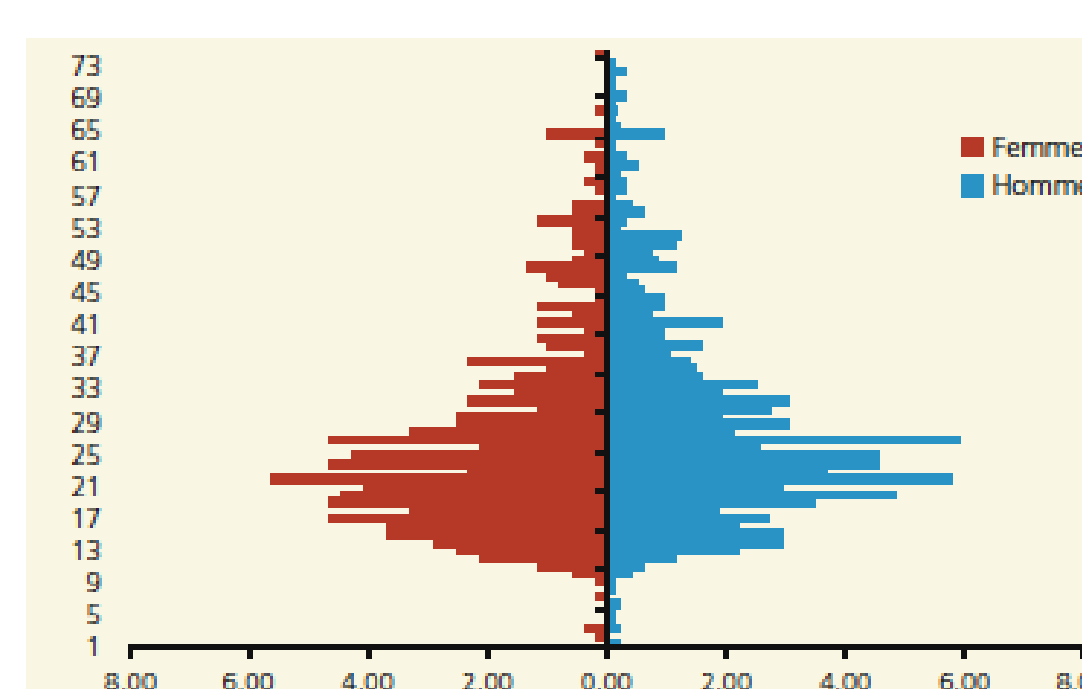
The trauma surveillance system is based on a geotracer, a GPS device that enables geographic position to be transmitted via SMS. It is activated by a police officer at the scene of the accident. Information on injuries is added later at the hospital.



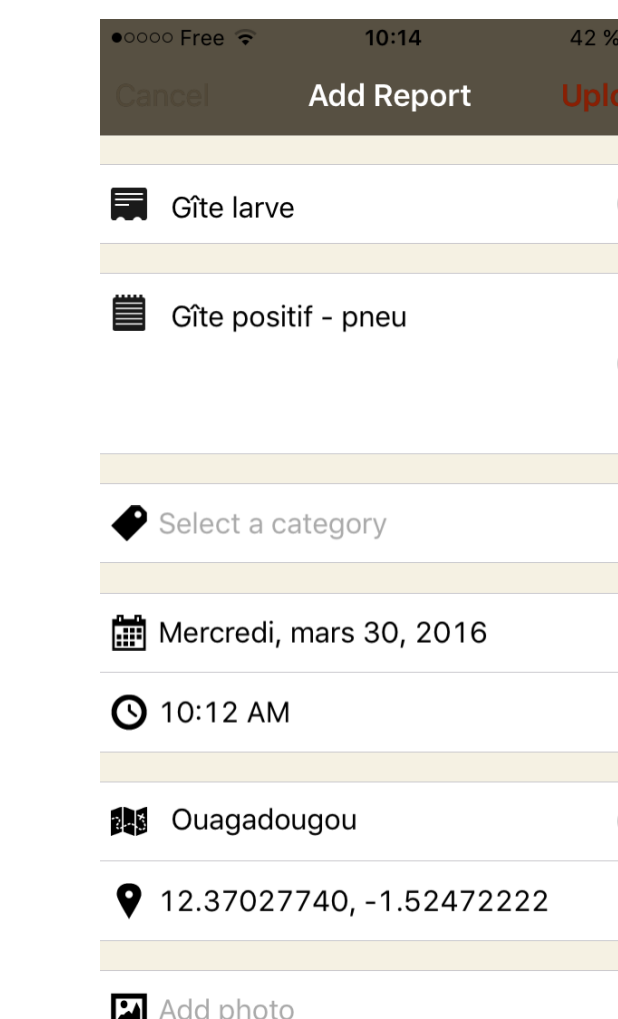
The platform allows the cases that are geolocated and aggregated on the map to be exported to the Geographic Information Systems (GIS).

Spatial analyses (kernel density) show concentrations of traffic accidents in the city.

The surveillance system produces graphics and statistics on traffic accident morbidity by age and sex.



Dengue surveillance



The dengue surveillance system receives data (dengue cases, presence of larvae, GPS position) via an Android application installed on a smartphone that uploads the data over 3G.

The surveyor regularly checks the traps set up in Ouagadougou neighborhoods and inspects the dwellings of people diagnosed with dengue.



With the map interface it is possible to display dengue cases or the presence of positive larval breeding habitats.

A temporal display is also available to visualize the dynamics of the epidemic.

Conclusions

These surveillance systems and their associated technologies are effective, simple, and affordable. In a context where there is a significant paper-oriented culture, incorporating the systematic use of these tools into the surveillance practices of health workers and police is a challenge.

Several elements are needed to deploy these technological solutions:

- Smartphone-type devices equipped with GPS;
- A remote computer server that will ensure continuity of data acquisition and can cope with power interruptions;
- Training of health workers and surveyors in the use of the data collection tool, making them aware of the timesaving aspects, reliability, and value of surveillance systems.

These surveillance systems are based on mobile and open-source technologies and perform the essential functions required:

- Monitoring data collection in real time;
- Creating statistical and geolocated databases;
- Exporting data for in-depth analyses.

They ensure dynamic surveillance that can:

- Describe an endemic situation from statistical, spatial, and temporal standpoints;
- Identify trends in the health phenomenon under surveillance;
- Provide alerts regarding unusual situations;
- Conduct precise investigations thanks to geolocation.

However, some limitations remain:

- Uncertainty about whether the data are exhaustive;
- Limited acceptance by national health services.

Data management and analysis: Data analysis was performed with ArcGIS 10.3.

Ethical considerations: The study protocol was reviewed and approved by the National Health Ethics Committee of Burkina Faso and the Institutional Review Board of CRCHUM.

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