# POLICY BRIEF

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## Using smart phones coupled with intelligent mobile and web applications for enhancing disease surveillance in Tanzania

**Key messages**

- The disease surveillance system in Tanzania captures clinical cases, mainly at health facilities, whilst a large proportion of population does not have access to these facilities.
- Disease surveillance today is more complex as it involves capturing information from various sources including demographical, ecological and climatological data
- A number of on-going projects/programmes in Tanzania that collect surveillance and other public health-related data are not integrated into the formal surveillance system.
- Mobile and Web applications are better equipped as data collection tools for disease surveillance as they may include location, images and videos that are key data items that may aid diagnosis and management of disease outbreaks.
- Digital-based surveillance is envisaged to reduce inefficiencies in data collection and reporting and hence prompt response.
- Despite availability of these tools, the human and animal health surveillance systems are largely paper-based contributing to the sub-optimal performance.
- This policy brief recommends the adoption of smart phones coupled with intelligent mobile and web apps for improving the electronic system of disease surveillance in Tanzania

**Executive summary**

Disease surveillance today is more complex as it involves capturing information from various sources; clinical, demographical, ecological and climatological data. In recent years, in low-and-middle-income-countries, mobile technologies have emerged as a promising solution for obtaining, transmitting, and analysing health data in a timely fashion. Despite availability of these opportunities, the human and animal health surveillance systems are largely paper-based and depend on capturing data at health facilities or using employed health practitioners which contribute to the sub-optimal performance of these systems. In response to these challenges, the Southern African Centre for Infectious Disease Surveillance has developed a smart phone community–based surveillance programme for human and animal diseases in Tanzania. This programme has been shown to effectively complement the official surveillance system in three pilot districts in Tanzania where it was tested. The programme is quite likely to complement the national integrated disease surveillance and response (IDSR) strategy. However, to scale up, it will involve the development of protocols, guidelines and other requirements to facilitate the use of mobile and web apps as an additional data capture tools to complement the e-IDSR. This policy brief, therefore, recommends the adoption of smart phones coupled with intelligent mobile and web apps for improving the disease surveillance in Tanzania.

**The Problem**

Disease surveillance is the foundation of public health practice – providing data to inform decision making and response to health events including disease outbreaks. Until recently, surveillance systems in low-and-middle income countries were fairly simple, paper-based and required disease-specific data collection forms that were completed by health care providers and sent to the district, regional/provincial and national levels. Moreover, the systems were often based on aggregated data generated at health care facilities (Doherr, 2001). The disease surveillance programme of today is more complex as it requires capturing of information, including clinical, demographical, ecological and climatological data, from various sources.

Evidences available have indicated that community-based surveillance may complement the formal facility based surveillance systems in a number of countries (Mugunier & Irungu, 2004; Allport et al., 2005; Robertson et al., 2010). However, integrating community-based surveillance into the formal systems is yet to happen in Tanzania. The fear arises on the likelihood that to integrate self-reporting, community driven surveillance systems may open up possibilities of manipulating surveillance data, result in high noise level, increase false positive cases, hence raising unauthorized alarms that may have adverse effects to the economy and national security. Technically these concerns relate to data security, authorization, validity, storage, accessibility and availability.

In addition, the recent initiative to implement a One Health approach in disease prevention and control – and combining human and animal surveillance systems, strategies and techniques will require a change of ideology and paradigm shift in government structures and planning. Technically this relates to harmonizing data sets, database schemas, Application Programming Interface (API)'s for data sharing and redesign of entire information architecture. The Tanzania Ministry of Health' e-Health strategy (MoHSW, 2013) identifies such lack of availability of proper information sharing systems within and outside the health sector as a major weakness to Tanzania's healthcare system.

The Ministry of Health's electronic integrated disease surveillance and response (e-IDSR) has already addressed a number of the technical challenges by introducing mobile phone based reporting and deployment of District Health Information version 2 (DHIS2) as repository for storing and analysing disease surveillance data. As such e-IDSR has transformed disease surveillance in Tanzania, with 70% increase in reporting rates with over 13% of the primary health care facilities implementing the tool on weekly basis (http://p4-project.org/wp-content/uploads/2014/12/Tanzania-mHealth_PPP-Insert_USL.pdf).

The e-IDSR tool is based on Unstructured Supplementary Service Data (USSD) and short messaging service (SMS) technology, which work via a two-way question and answer session over global system for mobile communication (GSM) network. The advantage of such an approach is that it is compatible with all makes of mobile phones, and all users generally are well acquainted to the technology due to the increase of mobile money transactions and airtime bundle purchases that utilizes the same technology. However, the challenges of using this technology in respect to disease surveillance include (i) timeout problems with USSD, due to users taking too long to reply an answer, which may require to restart the entire submission process; (ii) its inability to collect rich media items like images, videos and audio which may be crucial in understanding the nature of health event; (iii) its inability to collect geographical location for developing maps that provide a holistic view of clusters of disease patterns; and (iv) tightly knit nature with mobile operators, thus it is not dynamic and flexible enough for health related organisations to rapidly roll out surveillance forms - making it unsuitable for rapid deployment of fit-for-purpose surveillance forms based on the nature of a disease outbreak.

Recent on the use of mobile technologies for disease surveillance in humans and animals (Mwabukusi et al., 2014; Beda et al., 2015) have shown that smartphones can capture disease surveillance data including geographical location, images from both humans and animals. They have demonstrated the usefulness of smartphone apps in providing near to real-time data, and the potential for enhancing timely response in rural remote areas in Tanzania. The data generated using this system has shown to effectively complement the official surveillance systems in the locations where it was deployed. In addition, it has shown potential to complement the national human and animal health surveillance systems run by the government and provide a much holistic picture of the public health events. Studies in Tanzania and elsewhere (Robertson et al., 2010; Ndume et al., 2013; Sayalel, 2013; Braun et al., 2016) have shown the capacity of the tools to collect a large set of health related data from both animals, humans, community and environment. A study in Sri Lanka has already established that mobile phone based surveillance is feasible in lower-resource settings (Robertson et al., 2010).

**Policy options**

It is recommended to adopt smart phones coupled with intelligent mobile and web apps for improving the electronic system of disease surveillance in Tanzania. This will require development of protocols, guidelines and other requirements to aid the use of mobile and web app as an additional option to e-IDSR. In addition, a standardized way to streamline

all e-health related collection tools to seamlessly and rapidly share data to a centralized server managed by the relevant government ministries will be established. This will encourage organization in health arena to develop applications based on the set guidelines by Ministry of Health and seek approval for their data sources to be part of e-IDSR so that they are relevant and contribute to national disease surveillance interests. It will also make possible for animal health data to be seamlessly shared between the ministries responsible for public health and animal health and the vice versa. This opens up the opportunity of vital interconnectedness of humans, animals and environmental data that can improve traditional disease-surveillance systems.

Fundamentally such a move will pave the way for the government ministries to be able to develop and deploy a myriad of additional solutions for disease surveillance and response at all levels. In particular, having a mobile app that is flexible and dynamic to rapidly create and distribute new surveillance forms coupled with video based training guides direct to smart phones of participating officials, will ultimately improve the surveillance systems.

**Implementation considerations**

*Guidelines:* Develop transparent procedures for registering institutions that generate and intend to share data with the ministry and issue a unique key (API key) to be used whenever sharing data.

*Technical backstopping:* Incorporate information communication technology (ICT) component with the ministerial units responsible for disease surveillance to secure, manage and maintain database and network connections required to host and operationalize sharing of data from participating systems.

*Integration:* Develop a set of protocols, and tools that specify how software components should interact between ministries and participating systems including community-based approaches to foster seamless and rapid data sharing.

*Software development:* Develop new software that may (i) integrate with DHIS2, so as to take advantage of the additional data shared by participating systems; and (ii) take advantage of new data types and functionalities like geographical positioning system (GPS), images, videos and two-way communication to enhance the current surveillance system.

*Price of data packages:* Negotiate with mobile phone operators to provide inexpensive and/or subsidized data charges to public/animal surveillance systems.
Training: Video, audio tutorials may be pre-recorded and rapidly distributed to smart phone of health officials at a cost effective way to provide training on new mobile-phone-based surveillance forms.

*Access to Internet in remote areas:* Data network coverage in Tanzania is extensive, but for areas where there seems to be a challenge, surveillance may continue to use traditional mode (pen-to-paper, SMS or USSD). Otherwise, surveillance staff and trained community personnel may continue collect data offline and when at an area where data network is available, reports may be submitted.

*DHIS2 as main database:* Treating DHIS2 as core repository of all health data collected will require additional data banks setup and potentially the need to modify system user interface so as to be able to take advantage of new functionalities that may be added by mobile apps created (two-way communication, feedback, etc.). This will require establishment or strengthening of an ICT unit to manage and develop these changes.

A large number of health officials already possess smart phones and/or health facilities are equipped with computers capable of being used as a disease surveillance tool. Thus there is no need for huge investment in reporting tools as the current e-IDSR system via USSD may be used; mobile and web apps may be treated as an option. The introduction of this initiative requires a minimum of two days to train public/animal health surveillance staff in using mobile and/or web app as e-IDSR tools. This is slightly less than the minimum three days training used for the ongoing e-IDSR USSD implementation.

The new initiative may face some challenges. Allowing non-official data sets to seamlessly and rapidly share health related data opens up possibilities of manipulating surveillance data, high noise level and an increase in false positive cases. This is likely to raise unauthorized alarms that may have adverse effects to the economy and national security. False data submitted to the system may be mitigated by only considering data from health officials as valid data. Any data collected and shared to national health database from other approved sources are to be treated as additional data. It is envisaged that the human capacity strengthening going on in Tanzania

when coupled with technology will be the future key to early detection of emerging or re-emerging infectious diseases.

**Competing interests**

The authors declare that they have no competing interests.

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**About the Institutions**

Southern African Centre for Infectious Disease Surveillance

Southern African Centre for Infectious Disease Surveillance is a One Health Virtual Centre that links academic and research institutions involved in infectious disease surveillance of humans and animals in Southern and Eastern Africa. It was formed in 2008 with Sokoine University of Agriculture, in Tanzania, as the Lead Institution.

**National Institute for Medical Research**

The National Institute for Medical Research is a public health research institution established by the Act of Parliament No. 23 of 1979 with the mandate to carry out, co-ordinate, monitor and control health research in the United Republic of Tanzania

**Sokoine University of Agriculture**

Sokoine University of Agriculture (SUA) is a Public University established by SUA Charter of 2007 which is granted under the Universities Act, 2005 of Tanzania and having its principal office at Sokoine University of Agriculture, Main campus, Morogoro, Tanzania