HOW CAN MOBILE PHONES CONTRIBUTE TO WATER QUALITY MONITORING EFFORTS IN AFRICA?

Monitoring for Safe Water (MfSW) is an action research program that promotes drinking water safety through improved monitoring. The Aquaya Institute (Aquaya) launched MfSW with a grant from the Bill & Melinda Gates Foundation. Partners have included the African Water Association (AfWA), the International Water Association (IWA), and the World Health Organization (WHO).

INTRODUCTION

The United Nation's 2030 Agenda for Sustainable Development includes a target for achieving universal and equitable access to safe and affordable water for all by 2030. In measuring and guiding progress towards this aspirational goal, the efficient flow of water quality data among relevant actors is crucial. To understand the potential for ICT applications in water quality data management, Aquaya researchers published an analysis of information flows within regulated monitoring institutions across Africa:

Kumpel, E., Peletz, R., Bonham, M., Fay, A., Cock-Esteb, A., & Khush, R. (2015). When Are Mobile Phones Useful for Water Quality Data Collection? An Analysis of Data Flows and ICT Applications among Regulated Monitoring Institutions in Sub-Saharan Africa. International Journal of Environmental Research and Public Health, 12(9), 10846-10860.

This brief summarizes the results of their analysis.

Main Findings

1. Water quality testing mostly occurred in centralized locations—laboratories or offices—rather than at water sources.
2. Mobile phone applications for data management are most likely to benefit institutions that manage multiple remote testing sites and who lack networked computers.
3. Health surveillance agencies are required to monitor a broad range of activities beyond water safety. Mobile phone data applications for these agencies should address multiple data collection needs.
4. Mobile phones are only useful where support and resources for conducting water quality monitoring activities are already available.

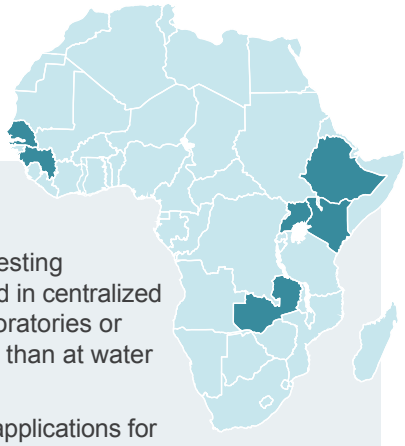

Figure 1: 26 institutions in 6 countries participated in the study

PROGRAM STRUCTURES AMONG MFSW INSTITUTIONS

In most countries, regulations for managing drinking water safety specify two monitoring requirements: 1) *operational* monitoring by water suppliers to ensure the safety of their treatment and distribution processes; and 2) *surveillance* monitoring by an independent agency, usually responsible for public health, to ensure that all drinking water sources comply with national standards. To study monitoring structures and performance, the MfSW program enrolled 26 water suppliers and surveillance agencies across six sub-Saharan African countries (Kenya, Uganda, Zambia, Ethiopia, Senegal, and Guinea).

This research program with 26 MfSW collaborating institutions included extensive qualitative and quantitative data collection.

Water quality program structures among MfSW institutions fell into four typologies, which are described in Table 1.

Table 1: Typologies of water quality monitoring programs

Typology	Type A (All-In-One)	Type B (Pass-it-on)	Type C (Decentralized)	Type D (Independent Teams)
# Of testing locations	1	1	>1	>1
# Of collectors/ testers	Variable	>2 collectors, fewer testers	1-2 collectors and testers	>2 collectors, >2 testers
Staff collecting samples and staff conducting tests	Same	Different	Same	Same
# Of MfSW institutions	12 institutions	4 institutions	7 institutions	3 institutions
Example of typology	A water supplier in Kenya relied on two staff members to collect samples, transport them to the lab, perform tests, record results in a notebook, and enter them into a computer at the testing location	In a Zambian DHO 15 EHTs from different health facilities collected samples, delivered them to a hospital lab where lab staff received samples, conducted tests and recorded results in a data logbook. Data was transferred to an electronic database by DHO staff	A regional water supplier in Zambia had eight districts, each with one or two lab technicians that collected water samples, transported them to the lab in their own town, conducted tests, entered results in a digital sheet and forwarded it to the regional center via email	In a Kenyan DHO, multiple CHWs from each of the 4 sub-areas collected samples, transported them to their own sub-area health centers, and conducted testing while supervised by CHEWs who recorded results on paper logs and transported them to the district hospital for compilation and digital entry
Main data management challenge	With only few staff, staff turn-over has the potential to jeopardize monitoring and reporting activities	There is potential for poor coordination and mixing of samples with lab staff when handing off water samples	It is challenging to consolidate data from different locations (that have different reporting formats)	It is challenging to ensure data consistency, both across multiple testing locations and across multiple testers within the same location.

DHO: District Health Office, EHTs: Environmental Health Technologists, CHWs: Community Health Workers, CHEWs: Community Health Extension Workers.

The institutions were observed to conduct almost all water quality tests in formal laboratories or with a portable kit in an office rather than at the point of water sample collection. Occasionally, assays for residual chlorine levels were conducted at water sample collection points. Staff testing water quality most often recorded results in lab books, which were transcribed to electronic spreadsheets and shared via the Internet (the latter was likely influenced by the structure of the MfSW program, which required institutions to email the data). The institutions faced various challenges with electronic data management: lack of computers, sharing of computers among different departments, intermittent internet, frequent power outages that damaged equipment, viruses that corrupted files, and loss of flash drives.

Since Type A and B institutions generated water quality information at a single, central location, their requirements for constant data transfers were reduced. In contrast, Type C and D institutions collated water quality data from multiple sites. Institutions with these typologies would likely benefit from mobile phone-based data management applications, particularly at sites that lack computers or where Internet access is limited. Mobile phone applications may also be useful for surveillance institutions, which often conduct sanitary inspections of water points in addition to collecting samples.

SERVICE NATIONAL DE L'HYGIÈNE

Aquaya developed a mobile phone application for field data collection by the Service National de l'Hygiène (SNH) in Senegal. SNH is a health surveillance agency responsible for public health; they educate, enforce and monitor hygiene practices, and conduct vector control coupled with providing prophylaxis for endemic epidemic diseases. With respect to water quality monitoring, SNH is a Type D institution. SNH health agents were provided with Android phones that carried CommCare, a data collection application developed by Dimagi. From 2014 to 2015 SNH agents recorded the following information on CommCare for each water sample collected:

1. Information about the water source: GPS coordinates, type of water source, sanitary conditions at the water source, and water quality parameters tested onsite;
2. Test results: the results of physico-chemical and microbial water quality analyses; and
3. The actions that agents took in response to contamination

SNH's experiences with the mobile phone application for water quality data management revealed both opportunities and challenges of introducing mobile phone applications into water quality monitoring programs. The main findings are summarized in Box 2.

CONCLUSIONS

Currently, water quality testing by water suppliers and surveillance agencies predominantly takes place in laboratories or offices, which generally have computers for data entry and sharing. However, the four testing program typologies that exist within African institutions show that some organizations manage networks of testing sites. In areas without computers or reliable internet access, mobile phone applications will facilitate water quality data entry, analysis, and sharing. The cost-effectiveness and usability of the applications, particularly among surveillance agencies, will improve if they can be applied to multiple data management needs, not just water quality.

SNH health agents collecting data on a mobile app, October 2014

Lessons learned from introducing a mobile phone application for water quality data management in a Type D institution.

1. Compared to computers, mobile phone literacy was high.
2. Water sampling and testing were not daily activities, therefore, staff sometimes forgot how to use dedicated phone applications for data entry and submission.
3. Continuous internal training and other supportive activities may be necessary to ensure efficient engagement of staff with mobile applications.
4. Support requirements will vary from one institution to another.
5. Using phone applications for multiple data collection activities, not just water quality data management, would improve their cost-effectiveness and reduce the need for re-trainings.

The full text can be found at: http://www.mdpi.com/1660-4601/12/9/10846

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