User Evaluation Indicates High Quality of the Surveillance Outbreak Response Management and Analysis System (SORMAS) After Field Deployment in Nigeria in 2015 and 2018

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Abstract. During the West African Ebola virus disease outbreak in 2014-15, health agencies had severe challenges with case notification and contact tracing. To overcome these, we developed the Surveillance, Outbreak Response Management and Analysis System (SORMAS). The objective of this study was to measure perceived quality of SORMAS and its change over time. We ran a 4-week-pilot and 8-week-implementation of SORMAS among hospital informants in Kano state, Nigeria in 2015 and 2018 respectively. We carried out surveys after the pilot and implementation asking about usefulness and acceptability. We calculated the proportions of users per answer together with their 95% confidence intervals (CI) and compared whether the 2015 response distributions differed from those from 2018. Total of 31 and 74 hospital informants participated in the survey in 2015 and 2018, respectively. In 2018, 94% (CI: 89-100%) of users indicated that the tool was useful, 92% (CI: 86-98%) would recommend SORMAS to colleagues and 18% (CI: 10-28%) had login difficulties. In 2015, the proportions were 74% (CI: 59-90%), 90% (CI: 80-100%), and 87% (CI: 75-99%) respectively. Results indicate high usefulness and acceptability of SORMAS. We recommend mHealth tools to be

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evaluated to allow repeated measurements and comparisons between different versions and users.

Keywords. mHealth, eHealth, systematic evaluation, disease surveillance, outbreak response, open source, Africa, infectious disease, medical and health informatics

1. Introduction

During the West Africa Ebola virus disease (EVD) outbreak in 2014-15, it became very clear that response teams must be equipped with technologies enabling real-time digitalized reporting and response management in order to improve efficiency in outbreak containment [1]. This experience led to the development of the Surveillance, Outbreak Response Management and Analysis System (SORMAS). SORMAS is a mobile and web application that provides a platform to detect outbreaks, manage tasks, validate cases, coordinate with laboratories and perform contact tracing. SORMAS uses a bi-directional information exchange and feedback to the different users within the Integrated Disease Surveillance and Response System (IDSR), which defines the disease notification procedures, established in Africa. We piloted the first version of SORMAS in 2015 in the states of Kano and Oyo, in Nigeria and conducted a user evaluation on its usefulness and acceptability. In 2016 and 2017, we reprogrammed the system in a new platform and included additional functionalities. In December 2017, we initiated the deployment of the system with the new version (SORMAS 2017) in Kano State and conducted a new user evaluation in order to measure whether the usefulness and acceptability of the system had improved.

2. Methods

For SORMAS 2015, we used the In-Memory Database technology in the cloud-based SAP HANA platform [2] [3]. We programmed SORMAS 2017 based entirely on open source platforms using a PostgreSQL Relational Database Management System and VAADIN framework [4][5]. The hospital informants operated SORMAS with smartphones in 2015 and with tablets in 2017. In 2015 version, the login procedure was a 3-tier authentication protocol, whereas in the 2017 version user login required a one-time encrypted password stored on the device and a 4-digit pin to authenticate the app anytime it was in use. We conducted six design-thinking workshops with a total of 65 epidemiologists, clinicians, and laboratory experts from Germany and 8 African Countries. The team developed the disease specific process models for Ebola Virus Disease (EVD), Cholera, Measles and Highly Pathogenic Avian Influenza (HPAI) in SORMAS 2015 and additionally for Lassa fever, Monkeypox (MPX), Dengue fever, Yellow fever, Cerebrospinal Meningitis (CSM), and Plague in SORMAS 2017 [6, 7, 2, 8]. The tool contains user specific interfaces, including that for hospital informants who are in charge of reporting notifiable disease occurring in the health facilities, and for laboratory officers in charge of processing laboratory diagnosis. In 2015, we selected eight Local Government Areas (LGA) at random from both Oyo and Kano States to participate in the pilot [9]. Within these LGAs, the state epidemiologist selected 31 private and public health facilities based on previous reporting activities resulting in 31 participating hospital informants. In 2017, SORMAS was deployed in all private and public health facilities of two LGAs [10]. After a two-day training, we conducted a five-week pilot in June 2015 [10]. For SORMAS 2017, all participants attended a two-day basic and a one-day refresher training. We implemented a post-pilot questionnaire in July 2015 after the hospital informants had used SORMAS 2015 for 5 weeks and post-implementation questionnaire in February 2018 two months after deployment of SORMAS 2017. We asked the users whether they would want to use the tool for their routine surveillance work (usefulness: yes/no), if they would also recommend the tool to their colleagues (acceptability: yes/no) and whether the users had experienced problems in the login (log-in difficulty yes/no). The 2015 questionnaire was paper based [11], while the 2018 questionnaire was administered electronically with SurveyCTO [12]. Questionnaires from both years contained questions on 'age', 'sex', and 'type of facility and rural/urban settlement types'). We performed a comparison of the respondents' characteristics between 2015 and 2018 using chi-squared test and calculated response proportions and their 95% confidence intervals (CI) using STATA version 14 [13]. We secured written consent from study participants and survey completion was anonymized. The study proposal was submitted to the ethics committee at the Hannover Medical School and cleared by the national agency in charge in Nigeria (NCDC).

3. Results

In 2015, 31 hospital informants (100%) that participated in the pilot submitted their responses. In 2017, 80 hospital informants were recruited and trained, out of which 74 (93 %) participated in the post implementation survey. The mean age in 2015 was 40.0 years (standard deviation= 8.97) and 35.7 years in 2018 (standard deviation= 8.27). See Table 1 for respondents' distribution for age, sex, facility type and settlement. Table 2 demonstrates statistically significant improvements for usefulness, and ease of login and no significant differences with respect to acceptability, comparing 2015 and 2018.

Table 1: Comparison of survey respondents' characteristics between 2015 and 2018.

Variable	2015 (N=31) n (%)	2018 (N=74) n (%)	Chi2	p-value
Age (years)				
18-34	8 (26)	33 (45)	3.2	0.072
35-54	23 (74)	41 (55)		
Sex				
Female	8 (26)	12 (16)	1.3	0.254
Male	23 (74)	62 (84)		
Facility Type				
Public	20 (65)	50 (68)	0.1	0.762
Private	11 (35)	24 (32)		
Settlement				
Urban	16 (52)	54 (73)	4.5	0.034
Rural	15 (48)	20 (27)		

Table 2: Comparison of survey respondents' assessment on usefulness, acceptance and ease of login between 2015 and 2018 surveys.

Variable	2015 (N=31)		2018 (N=74)		Chi2	p-value
	n (%)	95% CI	n (%)	95% CI		
Usefulness: would want to use SORMAS in surveillance work						
Yes	23(74.2)	(58.8 - 89.6)	70(94.6)	(89.4- 99.7)	8.98	0.003
No	8(25.8)	(10.4 – 41.2)	4(5.4)	(0.3 – 10.6)		
Acceptability: would recommend SORMAS for their colleagues						
Yes	28(90.3)	(79.9 - 100)	68(91.9)	(85.7 - 98.1)	0.07	0.793
No	3(9.7)	(0 - 20.1)	6(8.1)	(1.9 - 14.3)		
Ease of login: encounter problems with SORMAS login						
Yes	27(87.1)	(75.3 – 98.9)	14(18.9)	(10.0 – 27.8)	42.67	<0.001
No	4(12.9)	(1.1 – 24.7)	60(81.1)	(72.2 - 90.0)		

4. Discussion

Overall, the user responses revealed significant improvement for usefulness and ease of login in the 2017 version of SORMAS compared to the 2015 version. In addition, in both surveys, a large majority of the respondents would recommend the tool to their colleagues. In 2015, the complex login process led to frequent typing errors and eventually caused the devices to be blocked. The changes in the login procedure alongside with the large screens of the mobile tablets enabled users to easily navigate through the app and most likely explain the improved user login experience of 2018 version. Even though we are now finding an improvement from the user perspective, demands on data security are increasing and may force developers to implement login procedures, which in the given setting lack practicability. In order to address this challenge, an enhancement of multi-factor authenticated key exchange protocols could be a solution [14]. The increase in usefulness in the 2018 survey is remarkable.

The following differences are likely to account for this improvement. SORMAS 2018 covers 10 disease instead of four in the 2015 version and includes the laboratories as additional users in the network. We believe that the major difference in usefulness rating results from multiple improvements of user interface design and user training and the fact that increased smartphone/tablet use in the country may also have contributed. However, this comparison also contains several limitations: The study populations are not identical, even if their demographic characteristics between the 2015 and the 2018 did not differ. Furthermore, improvements in the survey tool also limit comparability.

5. Conclusion

Hospital informants have repeatedly rated SORMAS very high on usefulness, acceptability, and reported clear improvement with respect to login procedures from the 2015 to the 2018 version. We will take the opportunity of continued SORMAS implementation in 2018 to analyze other data quality dimensions, such as completeness or timeliness.

6. Conflict of Interest

There is no conflict of interest.

7. Acknowledgment

We acknowledge the Federal Ministry of Education and Research (BMBF), German Centre for Infection Research (DZIF) and the German Corporation for International Cooperation (GIZ) for providing financial support for the SORMAS project.

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