

Research Paper

Knowledge and perception of the role of water, sanitation and hygiene in containment of Ebola virus disease among secondary school students in Ibadan, Nigeria

Faith I. Edoror, Elizabeth O. Oloruntoba  and Shade J. Akinsete

ABSTRACT

This study assessed the knowledge and perception of the role of water supply, sanitation and hygiene (WASH) in the containment of Ebola virus disease (EVD) among secondary school students in Ibadan, Nigeria. A cross-sectional study of 420 students from eight schools (public and private) in Ibadan was conducted. A semi-structured questionnaire and an observational checklist were used to collect data. Data were analysed using descriptive statistics, Chi-square test and logistic regression at 5% level of significance. Overall, 60% reported EVD was airborne. A majority (71%) of the respondents had good knowledge of EVD, while a majority (92%) had a good perception of the role of WASH in EVD containment. Class of respondents was significantly ($p = 0.045$) associated with knowledge of WASH. Although schools had satisfactory sanitary facilities, only a few (21%) sustained good hygiene practices at the end of the Ebola outbreak in Nigeria. Our findings revealed suboptimal knowledge on transmission of EVD, and unsustainable hygiene practices among secondary students post-Nigeria's EVD outbreak. High priority should be given to hygiene education among educators and students. Implementation of monitoring and evaluation of hygiene behaviour among secondary school students should also be a priority.

Key words | hygiene, knowledge and perception on Ebola virus disease, sanitation, schools, water supply

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INTRODUCTION

The 2014–2016 Ebola virus disease (EVD) epidemic was the largest ever recorded with 28,639 cases and 11,316 deaths (WHO 2016). As of December 2014, the number of Ebola cases was four times higher than the combined total of all past outbreaks (UNDP 2015). While past outbreaks were relatively confined to rural areas, the recent outbreak was widespread in the urban areas. In Nigeria, among 20 reported cases, eight deaths were recorded (WHO 2014a) during the short-term outbreak of EVD in 2014. The World Health Organization (WHO) declared Nigeria EVD

free on 20 October 2014, after no new cases had been detected for 42 days (WHO 2014b). However, other West African countries suffered ongoing EVD transmission (Althaus *et al.* 2015).

The Ebola virus is a zoonotic pathogen, and its circulation among humans is rare, thus the outbreaks are intermittent and unpredictable (Troncoso 2015). Ebola is a traumatic illness both in terms of symptom severity and mortality rates (Van Bortel *et al.* 2016). With respect to its unpredictable nature, re-emergence is likely to be

spontaneous within the West African region. The infection spread occurs through transmission by direct contact with body fluids such as blood, vomit or secretions (urine, saliva, faeces, sweat and semen) of sick people (Troncoso 2015). Although fomite transmission has been suggested, the role of fomites appears to be relatively small, based on limited epidemiological data (Osterholm *et al.* 2015).

The EVD hit some of the world's poorest countries and some of the most vulnerable communities, with a devastating impact on children (UNICEF 2015). About one in five of those infected was a child (UNICEF 2015). Mortality rates are particularly high among children who have been infected and could be as high as 95% for those under the age of one (UNICEF 2015). More than 18,200 children lost one or both parents to Ebola, while many more saw a loved one die, with a resultant long-lasting emotional scar (UNICEF 2015). Furthermore, the impact of school closure on education and future opportunities of children during epidemics is very critical. School closure was one major way of curtailing the spread of EVD among children and the community in Nigeria and in other countries affected by the epidemic. Schools are one of the main platforms that engage children in the fight against EVD; thus, the importance of promoting major preventive steps in the fight against Ebola in schools (UNICEF 2015).

Safe water and good sanitation facilities are basic preventive measures against Ebola (UNICEF 2015), since safe water and sanitation facilities are akin to removal of some bodily fluids through which the disease is transmitted. Diarrhoea was one of the symptoms significantly associated with a fatal outcome of patients with confirmed EVD in Sierra Leone (Schieffelin *et al.* 2014). However, poor sanitation and inadequate water supply are major challenges in most schools in Nigeria. The post-Ebola re-opening of schools in Nigeria came with mandatory provision of basic preventive measures in schools, although the exact status of the provision of these basic measures in schools across Nigeria was unknown. Additionally, part of the recommendation for sustainable safe schools against future public health crises are basic health measures such as handwashing and sanitation practices. Sustainable hygiene behaviour changes are critical in the event of future EVD outbreaks. Consequently, it is imperative to determine the knowledge and perception of students

on EVD and their perception of the impact of proper sanitation and water supply on the prevention of EVD. Also, it is important to have baseline knowledge data of EVD which could assist in designing specific change interventions as well as for future assessment of the various interventions being used (CPPA 2014). Therefore, this study was conducted after the short-term Ebola crisis in Nigeria to assess the knowledge and perception status of EVD and the role of sanitation and water supply in the containment of the disease. It also helped to assess the sustainability of basic preventive measures put in place to contain the disease among secondary school students in Ibadan, Nigeria.

METHODS

Study design

A cross-sectional design that combined a questionnaire survey with observation component was adopted for the study. We compared the status of WASH facilities in private and public secondary schools and knowledge of the role they played in containment of EVD among the students.

Study area

The study was conducted in selected secondary schools in Ibadan North Local Government Area (IBNLGA) of Oyo State, Nigeria in July to October 2015. IBNLGA is one of the five urban LGAs in Ibadan Metropolis. It covers an area of 27.0 km², has a projected population of 432,900 and a population density of 16,033/km² in 2016.

Sample size determination

The sample size was calculated using the formula:

$$n = \frac{Z_{\alpha}^2 pq}{d^2}$$

where: n = minimum sample size;

$Z (1-\alpha)$ = a standard score at 95% confidence interval = 1.96;

$P_I = 53\% = 0.53$ (CPPA 2014);

$d = \text{degree of precision} = 0.05$.

$$n = \frac{Z_{\alpha}^2 pq}{d^2} = \frac{1.96^2 \times 0.53 \times 0.47}{0.0025}$$

$$n = 382$$

The minimum sample size for this study was supposed to be 382, an additional 10% non-response rate (38) gave a total of 420. Therefore, the minimum sample size used was 420.

Sampling technique

Participants who were secondary school students in junior secondary school one and two (JSS 1 and 2) and senior secondary one and two (SSS 1 and 2) were selected for the study. However, only participants who gave consent to participate in the study and were ready to provide accurate information were recruited for the study. Students in junior secondary and senior secondary school three classes were excluded from the study because they were not available in the schools at the time of the study as they were writing the West African Examination Council (WAEC) & National Examination Council (NECO) examinations and were hardly present in school.

A three-stage random sampling technique was employed to select the students. Four out of the 12 existing wards in IBNLGA were selected by balloting technique. Two schools (one public and one private) from each of the four wards were selected using a table of random numbers, yielding a total of eight schools (four public and four private). Generally in Nigeria, children in private schools reflect a higher socio-economic status than those in public schools which are government owned. Also, observation showed that the private schools had more WASH facilities. However, all schools have health education in their curricula as there is a unified curriculum prepared by the ministry of education for both private and public schools in Nigeria.

A list of students in each school was obtained and the sample size of 420 was proportionately allocated to the schools based on the student population in each school. A simple random sampling technique was used to select the number of students from JSS 1 and 2, and SSS 1 and 2 classes in the selected secondary schools.

Validity and reliability of instrument

Content validity of the questionnaire was carried out to determine its readability, clarity and comprehensiveness. A pre-test of the instrument was carried out among 40 students in a secondary school outside the LGA of interest. Data collected from the pre-test were coded and analysed using Cronbach alpha to measure the reliability of the instrument.

Data collection

A pre-tested, semi-structured, paper questionnaire was self-administered by the researchers to the students in both public and private secondary schools in their different classrooms during free periods. The survey, which covered a period of 4 weeks, was used to elicit information from the students on their knowledge and perception of EVD, water supply, sanitation and hygiene, and knowledge of the role of water supply, sanitation and hygiene in the containment of the EVD and the sustainability of facilities and preventive measures put in place during the outbreak. Participants in JSS 1 and 2 and SSS 1 and 2 who were willing to participate in the study and provide accurate information were recruited for the study. An observational checklist was used to document the sanitary conditions of the schools, available sources of water supply, the facilities that were in place for proper sanitation (e.g., toilets and taps for running water) and other environmental factors (e.g., waste disposal, and vector breeding around the school premises) that could pre-dispose the students to environment-related diseases.

Data analysis

The questionnaires were manually sorted and data were entered into SPSS software version 17 after validity checks through random checks and looking for variables that were outliers. Frequency tables and charts were then generated. A 12-point knowledge scale on knowledge of EVD ($\geq 6 = \text{good knowledge}$, $< 6 = \text{poor knowledge}$), 18-point knowledge scale on water supply, sanitation and hygiene (9–18 = good knowledge, 0–9 = poor knowledge), 12-point perception scale on water supply, sanitation and hygiene (7–12 = good perception, 0–6 = poor perception),

9-point perception scale on role of sanitation, hygiene and water supply in Ebola containment (5–9 = good knowledge, 1–4 = poor knowledge) and 18-point sustainability scale on hygiene practices after the EVD outbreak (12–18 = good, 1–11 = poor) were used to collect data. Data were analysed using descriptive statistics to get mean values and standard deviation, chi-square test to test for association between respondents' demographic characteristics and knowledge of EVD, and logistic regression to test the strengths of the associations at 5% level of significance.

Ethical consideration

Ethical approval for the study was obtained from the University Research Ethic Committee, University of Ibadan, Oyo State. Informed consent was obtained from parents/principals and assent from students before the commencement of the study. Participants were duly informed about the details of the study, nobody was forced to participate and withdrawal from the study was allowed at any point in time. All information obtained remained confidential.

RESULTS

Students' demographics

Mean age of respondents was 13 ± 2.0 , with 208 (50.5%) being females. Two hundred and sixty-nine (65%) of the respondents were from public secondary schools, 209 (51.2%) and 119 (48.8%) in JSS and SSS classes, respectively (Table 1).

Availability of WASH facilities in selected schools

Figures 1–3 illustrate the situation analysis of WASH facilities in the selected schools. It was observed that out of the eight schools studied six private schools had boreholes, while boreholes were observed in only two public schools. However, it was amazing that despite the fact that the schools are located in the urban centre, one of the public schools relied on a stream. In a similar manner, open defecation was observed in two of the public schools, while only one private school had soap for handwashing at the time of the study.

Table 1 | Socio-demographic characteristics of respondents

Variable	Frequency	Percentage
Sex		
Male	204	49.5
Female	208	50.5
Class		
JSS 1	116	28.4
JSS 2	93	22.8
SSS 1	102	25.0
SSS 2	97	23.8
School		
Public	269	65.0
Private	145	35.0
Religion		
Christianity	288	71.3
Islam	144	28.2
Others	2	0.5

Students' knowledge on EVD

Table 2 shows the students' understanding of EVD symptoms and mode of transmission. It is surprising that some of the respondents claimed that fever, diarrhoea and vomiting were not symptoms of EVD, while more than half (60%) stated that Ebola was airborne. Generally, the result revealed a total of 296 (70.5%) had good knowledge. There was a significant association between the class of student and knowledge of EVD. Those in JSS 2 and SSS 2 were five and seven times more likely to have good knowledge of EVD ($P=0.025$ and 0.008 ; C.I. = 1.1–4.0 and 1.3–4.7), respectively, than those in JSS 1 (Table 3).

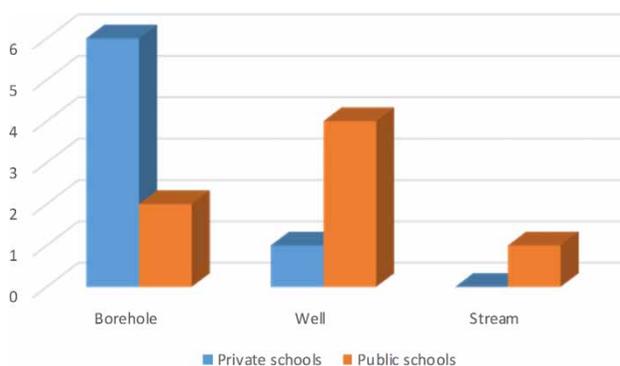


Figure 1 | Water supply facilities in selected schools.

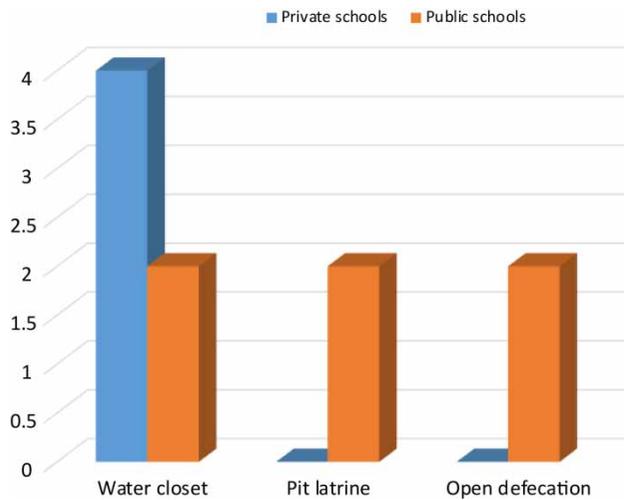


Figure 2 | Sanitation facilities in selected schools.

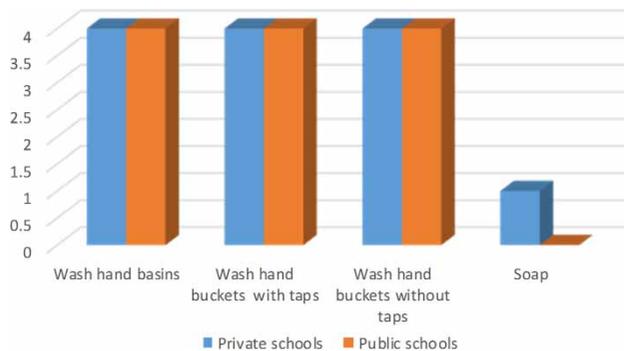


Figure 3 | Handwashing facilities in selected schools.

Students' knowledge on water supply, sanitation and hygiene (WASH)

Table 4 shows the students' knowledge about WASH services. Most respondents were able to identify the correct explanation of sanitation (95.8%) and hygiene (94.6%). Most (66.4%) identified diarrhoea as a disease majorly caused by poor sanitation and hygiene. However, a sizeable proportion (45.6%) did not know that ash can be used when soap is not available. Overall, the results showed that 398 (96.4%) had good knowledge of WASH. The results showed a statistically significant association between gender of respondents and their knowledge of WASH. Females were found to be six times more likely to have good knowledge ($P = 0.015$; C.I. = 0.031–0.68) of WASH than males (Table 5).

Table 2 | Knowledge of respondents on EVD

Variables	Frequency	Percentage
Which of the following is not a symptom of EVD?		
Fever	29	7.2
Vomiting	27	6.7
Loss of sight	301	75.1
Diarrhoea	44	11.0
How does the EVD spread?		
Contact with blood or sweat of an infected person	323	52.0
Exposure to contaminated needles	75	12.1
Transmitted from wild animals to humans	223	35.9
Ebola is airborne		
True	240	60
False	160	40
The natural host of EVD is believed to be?		
Monkey	312	52.2
Fruit bat	235	39.3
Mosquitoes	26	4.3
Rats	25	4.2

Table 3 | Association between class and school of respondents and knowledge of EVD

Variable	Odds ratio	95% C.I.	P-value
Class			
JSS 1	1.0		
JSS 2	5.03	1.1–4.0	0.025
SSS 1	0.3	0.7–2.1	0.587
SSS 2	7.1	1.3–4.7	0.008
School			
Public	1.0		
Private	31.1	2.9–9.5	<0.0001

Perception of respondents on adequate water supply, sanitation and hygiene (WASH)

Table 6 presents the perception of students on the adequacy and management of WASH facilities in their schools. About 87% of the respondents agreed that improper management of waste and standing water is a risk to human health. However, about 18% either did not know that exposed excreta

Table 4 | Knowledge of respondents on water supply, sanitation and hygiene (WASH)

Variables	Frequency	Percentage
Sanitation involves prevention of human contact with waste and excreta		
Yes	391	95.8
No	17	4.2
Hygiene refers to the conditions and practices that help to maintain health and prevent the spread of diseases		
Yes	385	94.6
No	22	5.4
Diarrhoea is not a major disease caused by poor sanitation and hygiene		
Yes	134	33.7
No	264	66.4
Can ash be used for handwashing in the absence of soap?		
Yes	215	54.4
No	180	45.6

Table 5 | Association between class and gender of respondent and knowledge of and water supply, sanitation, and hygiene

Variables	Odds ratio	95% C.I.	P-value
Class			
JSS 1	1.0		
JSS 2	0	0	1.0
SSS 1	0.7	0.36–10.40	0.44
SSS 2	1.3	0.15–1.7	0.3
Gender			
Male	1.0		
Female	6.0	0.031–0.680	0.015

could cause spread of diseases, while about 15% did not know that handwashing with soap prevents diseases. In spite of the fact that 384 (93.0%) of the students had good perception of WASH adequacy and management, nearly half (46%) incorrectly mentioned that ash and water cannot be used for handwashing in the absence of soap.

Perception of respondents on the role of WASH in Ebola containment

A majority of the respondents (>80%) agreed that access to sufficient water supply, proper sanitation, handwashing with

Table 6 | Perception of respondents on adequate sanitation, water supply and hygiene

Variable	Frequency	Percentage
Improper management of waste and standing water is risky to human health		
Agree	350	87.1
Disagree	28	7.0
Not sure	24	6.0
Exposed excreta causes and increases the spread of diseases		
Agree	327	81.8
Disagree	36	9.0
Not sure	37	9.3
Handwashing with soap helps in the prevention of diseases		
Agree	350	86.0
Disagree	39	9.6
Not sure	18	4.4
Adequate water supply in schools is mandatory		
Agree	350	86.0
Disagree	39	9.6
Not sure	18	4.4

soap and running water, as well as personal hygiene and use of sanitizers were the most effective way of preventing the Ebola virus (Table 7). Overall, 82% agreed that the Ebola outbreak in Nigeria increased their practice of personal

Table 7 | Perception of respondents on the role of water supply, sanitation and hygiene in Ebola containment

Variables	Frequency	Percentage
Handwashing helps in the prevention of Ebola		
Agree	386	93.7
Disagree	11	2.6
Not sure	15	3.6
Ebola virus is best removed from hands with soap and running water		
Agree	300	73.5
Disagree	57	14.0
Not sure	51	12.5
Preferred way to remove Ebola virus from hands is with soap and water in a bowl		
Agree	185	45.7
Disagree	140	34.6
Not sure	80	19.8

and environmental hygiene. However, private school students were four times more likely to have a better perception of the role of WASH in EVD containment than public school students (P -value = 0.047; C.I. = 0.2–0.99).

Sustainability of hygiene practices and facilities introduced during the Ebola outbreak

Respondents reported that tap water (53%), waste bins (49%), wash hand basins (54%), wash hand buckets with taps (63%), wash hand buckets without taps (45%), hand sanitizers (62%) and other facilities (56%) were provided in their schools during the short-term Ebola outbreak. Results also show that 28.8%, 29.2% and 77.2% sustained the practice of handwashing prior to eating, after touching public facilities, and with water and soap after the short-term outbreak. Results showed that 79.3% (333) of the respondents did not sustain good hygiene practices after the EVD outbreak (Table 8).

DISCUSSION

Nigeria experienced a short-term (20 July–20 October 2014) EVD outbreak, and was declared EVD free on 20 October 2014, after no new cases had been detected for 42 days (World Health Organization 2014a). In Nigeria, spread of the disease was contained by rapid implementation of control measures (Althaus *et al.* 2015), such as an intense mass media campaign, health education and school advocacy visits with emphasis on general public protection and control measures (Ilesanmi & Alele 2015). The Ebola epidemic also received extensive and continuous media coverage in the USA where risk of contracting the virus was small (Rolison & Hanoch 2015).

A majority of the respondents in this study had good general knowledge of EVD, which corroborates the study of Ilesanmi & Alele (2016) who reported good general knowledge of EVD among secondary school students in Ondo State, Nigeria. Despite the general good knowledge on EVD demonstrated by the students, a large proportion of the study population incorrectly reported the disease was airborne, thus demonstrating a poor knowledge of transmission of EVD. This corroborated a study on

Table 8 | Sustainability of hygiene practices and facilities introduced during the EVD outbreak

Variables	Frequency	Percentage
During the EVD outbreak, how often did you wash your hands?		
Just before eating	201	25.7
After eating	165	21.1
After any handshake	166	21.2
After touching public facilities and objects	250	32.0
During the EVD outbreak, did you use hand sanitizers?		
Yes	313	79.2
No	82	20.8
Were you careful in the way your body comes in contact with people during the EVD outbreak?		
Yes	355	89.6
No	41	10.4
Presently, how often do you wash your hands?		
Just before eating	201	28.8
After eating	169	24.2
After any handshake	124	17.8
After touching public facilities and objects	204	29.2
Do you use hand sanitizers presently?		
Yes	215	56.6
No	165	43.4
Are you careful in the way your body comes in contact with people presently?		
Yes	306	76.7
No	93	23.3

Ebola risk perception in Germany that reported a high misperception among the participants (74%) that airborne transmission of EVD was possible (Rübsamen *et al.* 2015). Poor knowledge about the transmission routes of EVD, as observed in this study and that of Rübsamen *et al.* (2015), suggests the need to properly address this issue particularly since airborne transmission of Ebola virus has not yet been established, although transmission via airborne droplets and aerosols has been queried (Osterholm *et al.* 2015). The aforementioned can be substantiated with the claim that Ebola virus can be isolated from saliva, and viral particles have been identified in pulmonary alveoli on human autopsies, suggesting that infectious aerosols could be emitted from the respiratory tract (Osterholm *et al.* 2015).

Personal hygiene, especially handwashing and the use of hand sanitizers, were overtly emphasized (Ilesanmi & Alele 2015) during the short-term EDV outbreak in Nigeria. Since the mode of transmission of EVD was through close contact with body fluids such as blood, vomit or secretions of infected people (Troncoso 2015), personal and environmental hygiene will facilitate the prevention of human-to-human transmission of the disease (World Health Organization 2014c). A majority of the respondents in this study identified sanitation and hygiene as means for the prevention of spread of disease and promotion of human health. Similarly, a majority of the students agreed that handwashing with soap and running water was adequate in preventing transmission of Ebola virus.

However, private school students were found to be four times more likely to have a better perception of the role of WASH in EVD containment than public school students. Yet, noteworthy is the fact that a substantial proportion of the students incorrectly mentioned handwashing with soap and water in a bowl as the preferable way of preventing transmission of the Ebola virus. The misperception demonstrated in this study defeats the purpose of handwashing practice as a means of preventing disease transmission. Tetteh-Quarcoo *et al.* (2016) reported the presence of microbes of faecal and zoonotic origin isolated from 'bowl water' for communal handwashing in some preschools in Ghana. Thus, they suggested 'bowl water' should be considered a possible transmission route for microbes. Camacho *et al.* (2014) suggested changes in behaviour resulted in a significant reduction in the transmission of Ebola in their study. In another study in Germany, a large proportion of the participants reported their hygiene behaviour, especially handwashing, will increase if an EVD patient were flown from Africa to Germany and treated in a nearby hospital (Rübsamen *et al.* 2015). As might be expected, behavioural modifications during a disease outbreak are usually adopted, which was the case during the recent Ebola outbreak in Nigeria, as revealed in this study and a similar one reported by Ilesanmi & Alele (2016). The challenge, however, is the sustainability of the improved behaviours after the outbreak. Our findings revealed a poor sustainability of improved hygiene behaviour among secondary school students after Nigeria was declared Ebola free. This supports the findings of Ilesanmi & Alele (2015) that

positive hygiene practices upheld during the outbreak of EVD in Nigeria were likely to be abandoned and not sustained after Nigeria was declared Ebola free.

Limitation of the study

Some school principals were reluctant to release their students to fill the questionnaires, while some teachers were bent on influencing the responses of their students. These issues were handled tactically by giving a clear explanation that the names of the schools would be well protected. Data were collected from four classes: JSS and SSS 1 and 2 because JSS 3 and SSS 3 students were writing the WAEC & NECO examinations and were hardly present in school.

CONCLUSIONS

In conclusion, a large proportion of the study population incorrectly reported the disease was airborne, thus demonstrating a poor knowledge of transmission of EVD. Furthermore, a substantial proportion of the students incorrectly mentioned handwashing with soap and water in a bowl as the preferable way of preventing transmission of the Ebola virus, which could be considered a possible transmission route of microbes. Additionally, our findings revealed a poor sustainability of hygiene behaviour among secondary school students after Nigeria was declared Ebola free. Suboptimal knowledge and misperception of EVD will likely exacerbate reaction in the event of a future outbreak. Therefore, the issue of airborne transmission of EVD should be properly addressed. Proper WASH education is also recommended for administrators, staff and students of secondary schools. Since handwashing plays a crucial role in preventing transmission of diseases as well as EVD, high priority should be placed on adequate training for school administrators, staff and students of secondary schools as well as provision of the necessary facilities. Also, proper monitoring to ensure availability and sustainability of WASH facilities as well as implementation of monitoring and evaluation of hygiene behaviours among secondary school students is necessary to ensure preparedness for future outbreaks. As a matter of urgency, the

Ministries of Education and Health should work with the school administrators to put in place standard operating procedures for disease surveillance in various schools.

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