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The impact of Infection Prevention and control (IPC) bundle implementation on IPC compliance during the Ebola virus outbreak in Mbandaka/Democratic Republic of the Congo: a before and after design

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ABSTRACT

Objectives To assess the impact of refresher training of healthcare workers (HCWs) in infection prevention and control (IPC), ensuring consistent adequate supplies and availability of IPC kits and carrying out weekly monitoring of IPC performance in healthcare facilities (HCFs)

Design This was a before and after comparison study

Settings This study was conducted from June to July 2018 during an Ebola virus disease (EVD) outbreak in Equateur Province in the Democratic Republic of the Congo (DRC).

Participants 48 HCFs

Interventions HCWs capacity building in basic IPC, IPC kit donation and IPC mentoring.

Primary outcome measures IPC score

Results 48 HCFs were evaluated and 878 HCWs were trained, of whom 437 were women and 441 were men. The mean IPC score at baseline was modestly higher in hospitals (8%) compared with medical centres (4%) and health centres (4%), respectively. The mean IPC score at follow-up significantly increased to 50% in hospitals, 39% in medical centres and 36% in health centres (p value<0.001). The aggregate mean IPC score at baseline for all HCFs, combined was 4.41% and at follow-up it was 39.51% with a mean difference of 35.08% (p-value<0.001).

Conclusions Implementation of HCW capacity building in IPC, IPC kit donation to HCF and mentoring in IPC improved IPC compliance during the ninth EVD outbreak in the DRC.

Strengths and limitations of this study

- By using a pre-test post-test methodology that measured the infection prevention and control (IPC) compliance, this study gave a clear picture of the role of healthcare workers' capacity building in basic IPC, IPC kit donation and IPC mentoring in the improvement of IPC compliance in healthcare facilities (HCFs) during an Ebola virus disease outbreak
- The IPC scorecard for assessment of HCFs allows for a rapid evaluation and it can help to monitor IPC compliance in HCF on a weekly basis.
- This IPC scorecard has the advantage that it has been used during other haemorrhagic fever outbreaks (Lassa Fever in Nigeria) and has produced good results.
- The main limitation of this scorecard is that it needs to be used by an experienced IPC specialist. Therefore, during an outbreak, especially in developing countries where there is a lack of IPC specialists, intensive training for locally recruited staff is needed so the tool can be used efficiently.

INTRODUCTION

Every year, the WHO African region records over 100 public health emergencies. Over 80% of these emergencies are due to infectious diseases; of particular concern are emerging and re-emerging pathogens. For instance, Ebola and Marburg viruses, previously suspected to be rare, have recently caused major outbreaks in the region.[1]

Between 5th May to 24th July 2018, the Democratic Republic of the Congo (DRC) faced its ninth Ebola virus disease (EVD) outbreak. The EVD outbreak spread in the rural health zones of Bikoro, Iboko and the urban health zones of Bokenge, Mbandaka and Wangata, all in the province of Equateur. In all, 54 suspect EVD cases were identified during the epidemic among which 38 were

confirmed and 16 were probable. In total, 33 of all these cases died with an overall case fatality rate of 61%. Seven of all these cases were healthcare workers (HCWs) and two of them died.[2]

EVD is caused by a filamentous RNA virus that belongs to the family of filoviridae, genus Ebolavirus.[3] The disease is transmitted by direct contact with infected blood or bodily fluids and HCWs have frequently been infected while treating patients when infection prevention and control (IPC) precautions are not strictly practised.[4 5]

IPC measures are critically important in stopping the transmission of EVD. IPC interventions during EVD outbreaks are essentially comprised of (1) standard precaution measures (hand hygiene and personal protective equipment (PPE)), (2) case detection and triage strategies, (3) suspected case isolation, (4) waste and linen management and (5) safe and dignified burial (SDB).[6–8]

In this outbreak response research, we assessed the impact of refresher training of HCW in IPC, ensuring consistent adequate supplies and availability of IPC kits (PPEs, IPC supplies) and IPC mentoring of HCW in healthcare facilities (HCFs) (non-Ebola treatment centres) during the 2018 Equateur EVD outbreak in Bolenge, Mbandaka and Wangata Health Zones.

METHODS

Study design, settings and participants

This was an analytical study designed to allow before and after intervention comparisons that evaluated the impact of HCW training, IPC kits donations in HCFs and IPC mentoring on IPC compliance in non-Ebola health facilities in Bolenge, Mbandaka and Wangata Health Zones, in Equateur Province, DRC. This study was conducted from June to July 2018. The city of Mbandaka, with a population of 300 000 inhabitants,[9] is divided into three health zones: Bolenge, Mbandaka and Wangata health zones. In all, 48 HCFs of these three health zones were involved in this study. In Bolenge health zone, 8 HCFs were involved; in Mbandaka health zone 23 HCFs and in Wangata health zone 17 HCFs.

Intervention

HCW capacity building in basic IPC, IPC kit donation and IPC mentoring.

HCWs capacity building

During this study, 878 HCWs were trained in IPC. Training modules were developed by the WHO and approved by the Ministry of health of the DRC. The duration of training sessions was 3 days. The first day, the training focused on basic principles of EVD and IPC standard precautions, on triage and isolation of patients and on intra-hospital surveillance. The second day, the trainees learn about injection safety, cleaning and decontamination of the environment, waste management, SDB and psychological aspects of EVD. The third day, the training focused on the IPC ring strategy, IPC kit constitution, IPC assessment of HCFs using the scorecard and stock management.

IPC kit donation

The following items made up the IPC kits: non-contact thermometer, examination gloves, surgical masks, N95 masks, alcohol-based hand rub gel, needle disposal safety box, rubbish bins, paper towels, soap, dishwashing gloves, chlorine, laboratory coat, impermeable coveralls, face shields, aprons, goggles, EVD case definition posters, stickers with the Ebola suspect case alert phone number, posters for hand hygiene and waste management, gumboots, plastic table, plastic chair, a chlorine sprayer, hand washing tap buckets and small waste disposal incinerators.

IPC mentoring

The IPC mentoring was done by IPC specialists from WHO. These specialists visited HCFs three times per week and were responsible for mentoring the IPC focal point of the HCF. The specialists also worked with the hospital team to plan, develop, implement and evaluate IPC within the HCF, and to organise HCW trainings.

Outcome: IPC compliance measuring

To determine the IPC scores of HCFs, a new IPC scorecard developed by WHO office for Africa and first used during the Lassa Fever outbreak in Nigeria in 2017–2018 was used. Data were collected by trained IPC specialists, different from those who provided training of HCW, IPC kit donations and IPC mentoring. An IPC needs assessment of HCFs was conducted using the IPC scorecard (translated into French and adapted to DRC's context). The scorecard was developed to serve two purposes: (1) initial rapid facility assessment and (2) weekly monitoring of the progress of IPC interventions. The scorecard was approved for use by the Ministry of Health of the DRC and focuses on 12 priority areas (parameters). Each area of intervention was scored on a scale of 0 to 2. A score of 2 represents adequate and functioning IPC priority area and a score of 0 indicates total absence of the IPC priority area. The 12 key IPC priority areas are combined to get a maximum aggregate health facility score of 24 (which represents 100% compliance).

The IPC scorecard assesses the availability of the following parameters: IPC coordinator or IPC team, security ring around suspected/confirmed cases, isolation areas, triage, hand hygiene stations, security of patients and families, adequate number of HCW, PPE availability, PPE utilisation, waste management, HCW trained in IPC, and mechanisms in place for SDB (table 1).

The baseline evaluation of the IPC compliance was made at the beginning of this study in each HCF, following which the IPC training was conducted and IPC supplies and kits were provided.

HCFs were categorised into three types: hospitals, medical centres and health centres. Hospitals were classed as such if they had multiple physicians and were listed as

Table 1 IPC check list and scorecard

Parameters for IPC rapid evaluation	Criteria
IPC coordinator or IPC team in place	► If present and functional=2 ► If present but not functional=1 ► If there is no IPC coordinator of IPC team in place=0
Perimeter around suspect/confirm cases	► The perimeter is completely closed=2 ► The perimeter is partially closed=1 ► The perimeter is totally opened=0
Isolation unit	► Isolation unit well circumscribed with beds, tables, bins, cemented or tiled floor, first-line drugs=2 ► Isolation unit but without all the necessary materials=1 ► No isolation unit=0
Triage system	► A fence around the health structure with only one entry; presence of at least one person for the triage; presence of hand hygiene facilities, non-contact thermometer, case definition sheet, suspect cases notification sheets and 24/7 services=2 ► If some of the above-mentioned conditions are not in place=1 ► No triage system=0
Hand hygiene	► Hand hygiene facilities in sufficient number with chlorinated water or with water and soap=2 ► One of the conditions above is not met=1 ► No hand hygiene facilities=0
Patients and family security	► Health structure fenced with presence of a guard who controls entries 24/7=2 ► One of the conditions above is not met=1 ► Absence=0
Number of HCWs	► Sufficient HCWs=2 ► Insufficient HCWs in the health structure=1 ► No HCW in the health structure=0
Availability of PPE	► PPE in the stock in adequate quantity=2 ► Insufficient quantity of PPE in the stock=1 ► No PPE in the stock=0
PPE utilisation	► Systematic and adequate use of PPE=2 ► Inadequate usage of PPE=1 ► HCW do not use PPE=0
Waste management	► Waste triage to the source, distance between bins is respected, coloured codes are respected, presence of an incinerator and presence of a placenta pit=2 ► One or more of the conditions is not respected=1 ► No waste management=0
HCWs training	► All HCWs are trained=2 ► Some HCW are trained=1 ► No HCW is trained=0
SDB	► The health structure supports initial interventions (family counselling and contact with the SDB team) and existence of a body bag and impermeable coveralls=2 ► If some interventions are taken but not all=1 ► No support for safe and dignified burial=0

HCWs, healthcare workers; IPC, Infection prevention and control; PPE, personal protective equipment; SDB, safe and dignified burial.

either general or university hospitals. The presence of at least one medical doctor in a HCF led to a designation of medical centre. Health centres were classified as facilities with nursing staff only (no physicians).

The gender of the HCW was collected as well as their field of study: medical doctors, nurses and other (administrators and hygienists).

Statistical analyses

A Shapiro test of normality was undertaken for numerical data and the results displayed a Gaussian distribution. Numerical data were analysed using the mean and SD. Categorical data were analysed using frequencies or percentages. A Pearson correlation test was run to determine the relationship between the numbers of HCW trained at each HCF and the IPC score. The one-way analysis of variance test was used to determine if there was a statistically significant difference in IPC score between the different types of HCFs.

To analyse the impact of IPC training on IPC compliance in all the HCFs involved in this study, the paired t-test

Table 2 Global characteristics of the study population

	Frequency	Percentage
HCW trained		
Female	437	49.77
Male	441	50.23
HCW trained		
Nurses	746	84.96
Medical doctors	70	7.97
Other	62	7.06
Healthcare facilities		
Hospitals	5	10.42
Medical centres	20	41.67
Health centres	23	41.92

HCW, healthcare workers.

was used comparing the IPC mean score of the baseline evaluation to the mean score of the follow-up evaluation after 5 weeks of intervention. A p value less than 0.05 was considered statistically significant. R software (Release V.1.67 (7152)—supplied with R 3.2.4, developed at Bell Laboratories (formerly AT&T, now Lucent Technologies) by John Chambers and colleagues) was used for all the statistical analyses.

Patient and public involvement

There was no patient involvement in this study. HCWs from the 48 HCFs involved in this study were trained in IPC.

RESULTS

During the Ebola outbreak in Mbandaka in 2018, 48 HCFs in three health zones were evaluated on IPC compliance. In these health zones, 878 HCWs were trained in basic IPC measures from a total of 1981 HCWs (44.32%); 441 were men and 437 were women (sex ratio=1:1). In Bolenge health zone, 75% of all HCW were trained; in Mbandaka health zone 38% were trained and in Wangata 47%. 85% of all the HCW trained were nurses, 8% were medical doctors and the remaining 7% was a mix of other cadres of HCW (hygienists, administrators, etc. In all, 23 (41.92%) of all the HCFs involved in this study were health centres, 20 (41.67%) were medical centres and 5 (10.42%) were hospitals (table 2).

The mean IPC score at baseline was modestly higher in hospitals (8%, SD: 2.82%) compared with medical centres (4%, SD: 1.29) and to health centres (4%, SD: 1.20%). The mean IPC score at follow-up significantly increased to 50.4% (SD: 11.92%, mean difference (MD): 42.4%, 95% CI: 29.4% to 55.3%, p value<0.001) in hospitals, 39.7% (SD: 15.57%, MD: 33.8, 95% CI: 25.69% to 41.9%, p value<0.001) in medical centres and 36.9% (SD: 14.28%, MD: 32.91, 95% CI: 26.71% to 39.11%, p value<0.001) in health centres.

Table 3 Improvement of IPC score of HCFs

HCF	IPC 1	IPC 2	P value
Hospitals	8 (2.82)	50 (11.92)	<0.001
Medical centres	4 (1.29)	39 (15.57)	<0.001
Health centres	4 (1.20)	36 (14.28)	<0.001
All HCFs	4.41 (1.88)	39.51 (14.87)	<0.001

IPC score 1 and 2: IPC score for the first and the second evaluation.
HCFs, healthcare facilities; IPC, infection prevention and control.

The aggregate mean IPC score at baseline for all health facilities, combined was 4.41% (SD: 1.88%) and at follow-up it was 39.51% (SD: 14.87%) with a MD of 35.08% (95% CI: 30.85% to 39.31%, p value<0.001). Table 3 resumes the performances of HCFs at the baseline and the follow-up assessments.

There was no correlation between the number of agents trained by HCFs and the IPC score of the follow-up evaluation (correlation factor: 0.29; p-value=0.093).

DISCUSSION

The IPC measures implemented in HCFs in this outbreak were critical to avoid EVD nosocomial transmission and contributed to the rapid control of this EVD outbreak along with other response pillars including: surveillance, vaccination, risk communication and case management. We hypothesised that IPC compliance would improve with the training of HCW, consistent provision of IPC kits and IPC mentoring in non-Ebola HCFs during the outbreak. To test this hypothesis, we designed and adapted a compliance scorecard that had been previously used in the Lassa Fever outbreak in Nigeria. Our hypothesis was validated and suggests that the scorecard is robust in recording IPC compliance. The MDs in IPC scores increased significantly after our interventions.

To ensure adequate consistency of all the interventions, weekly supervision and, in some instances, daily supervision depending on the initial score and the physical conditions of the facility was conducted by trained IPC specialists to monitor compliance and adherence to IPC measures and equipment put in place.

It is concerning that, while the IPC scores increased after the intervention, most HCFs still had an IPC score below 50%. This could be explained by some parameters that could not be directly enhanced without interventions by the government and the HCF. For example, the cadre and number of HCWs in any given facility are the responsibilities of the Ministry of Health. While WHO and IPC pillar partner trainers did their best to capacitate the vast majority of HCW in the targeted HCFs, WHO and partners could not unilaterally hire supplementary HCW for HCFs. Consequently, by the end of the epidemic, HCFs were performing better but were still not able to adequately resolve HCW staffing needs.

At the beginning of the study IPC scores in HCFs were very low. This is explained by the fact that in the DRC there is no routine IPC national programme due to inadequate resources in the public health sector. Therefore, the low scores are not surprising given the inadequate guidance and resourcing available to the HCWs at the beginning of the outbreak.

Furthermore, the poor state of HCFs combined with the low capacity of HCW on EVD prevention and control measures continues to pose a major challenge to DRC's ability to respond to future outbreaks of such magnitude. It would therefore be critical for the Ministry of Health to develop and implement a national IPC strategy. This proposed strategy should take into consideration the heterogeneous socio-political and economic contexts of DRC, as well as the vast geography and large population. Such a plan would reinforce health capacities in terms of IPC and will be a first-line barrier against future outbreaks.

Despite these challenges, opportunities for improvement exist. For example, in 2017, the DRC conducted a joint external evaluation (JEE) of its International Health Regulations capacities and is in the process of developing and reviewing the national action plan for health security. Gaps identified during the JEE and in the subsequent after-action review should be filled and urgently addressed by a robust IPC strategy and programme in the DRC.

During the 2014 EVD outbreak in Guinea, researchers demonstrated that IPC training was feasible in emergency settings and that it resulted in knowledge improvement.[10] In Guinea, the knowledge of Ebola among HCW was relatively high. In DRC, we observed that many HCWs were not aware of the disease and those who were aware held many misconceptions. Moving forward, there is a need to reinforce EVD training in preservice public health and medical schools in DRC and by extension to all African countries endemic for Ebola and other viral haemorrhagic disease.

In this study, we did not find any relationship between the number of HCW trained in HCFs and the level of the IPC score. We think that it is important to focus on the quality of training in HCFs instead of relying on the number of HCWs trained. It is more important to have a good IPC structure in an HCF than to have many trained individuals who are working without any coordination or quality control.

The IPC scorecard that we used in this study was employed for the first time in February 2018 in Irrua, Edo State, Nigeria during a major Lassa fever outbreak. It has the advantage that it can be used in a context of emergency by weekly assessments. This scorecard is, however, intended for use by senior IPC experts or HCWs with specialised training in IPC. The assumption therefore is that the user of the scorecard understands the details and complex nature of each parameter with the ability to rapidly assess each of them. This IPC scorecard should not replace the EVD preparedness checklist,[11] but should rather complement it.

Given the fragile nature of the health system in DRC and the ever-present risks of different outbreaks including cholera, yellow fever and Monkeypox, it is urgent and crucial to establish a national IPC programme which will consider the complex socio-political and geographical nature of the country. The EVD outbreak in 2014 in West Africa gave an opportunity to strengthen the health system and to set up (or reinforce) national IPC programmes in the affected countries.[12] In Sierra Leone, findings showed recovery over time in the post-Ebola period and that some health indicators might even be better than before the outbreak.[13 14]

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