

Defeating Ebola in Democratic Republic of the Congo Requires Strengthening its Health Systems and Infection Prevention and Control Programme in Particular: Lesson Learnt from the Current 2018-2020 DRC Ebola Virus Disease Outbreak

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Abstract

Background: The 10th outbreak of Ebola Virus Disease (EVD) in the Democratic Republic of the Congo (DRC) has been ongoing since August 2018. It is the largest-ever outbreak reported in the country and the world's second largest in history. It has been declared a Public Health Emergency of International Concern on 17 July 2019. The outbreak is ongoing in a densely-populated region, which is also experiencing a long-lasting humanitarian and security crisis. The affected region is characterised by insufficient prevention control practices in many health facilities and persistent reluctance in the community to accept response activities. Infection Prevention and Control and Hand Hygiene programmes were implemented in 10 hospitals to contribute in EVD containment and improving patient and healthcare personnel safety. The study aimed to evaluate whether the implementation of infection prevention and control programme in healthcare facilities improves the level of EVD preparedness and response.

Methods: This quasi-experimental intervention study was conducted in ten hospitals of Goma EVD sub coordination, north Kivu Province between April and October 2019. Infection Prevention and Control and Hand Hygiene programmes were implemented in 10 hospitals in North-Kivu province in DRC. The main activities were: baseline and impact assessments of IPC and hand hygiene programmes, baseline and impact assessments of hand hygiene practices (direct observation) for frontline healthcare workers, setting up hospital IPC committee and nomination of hospital IPC focal point, briefing of the IPC committee members and IPC focal point on their roles and responsibilities, a 5 day IPC training workshop for hospital senior managers, IPC committee members and IPC focal point. Data was analysed using Ms Excel.

Results: IPC programme baseline assessment demonstrated that 80% (8/10) of hospitals were at inadequate level, 20% (2/10) of hospitals were at basic level. Regarding hand hygiene programme, 80% (8/10) of hospitals were at inadequate level and 20% (2/10) of hospitals were at basic level. The findings from Hand hygiene practice baseline were: overall hand hygiene compliance was 33.1% (898/2713). All the 10 hospitals improved their hospital IPC level from inadequate level (8 hospitals) and basic level (2 hospitals) to intermediate level. Regarding hand hygiene programme, there were 4 hospitals that achieved advanced level, 5 hospitals achieved intermediate level and one hospital achieved basic level. During post-intervention assessment, hand hygiene practices among healthcare professionals improved significantly, whereby overall hand hygiene compliance improved from 33.1 (898/2713) to 70.5% (4368/6197).

Conclusion: The best way to combat outbreaks including EVD in any country of the world is to strengthen its health systems with focus on Infection Prevention and Control (IPC) programme. Implementation of IPC and hand hygiene programmes in healthcare facilities in North-Kivu Province in DRC helped was a key in defeating EVD outbreak in Goma and it proved how important is to invest on health systems strengthening and IPC programme. IPC and Hand hygiene programmes should be integrated into pre-service training for all health professionals. Communities should be engaged in IPC and hand hygiene programmes to ensure sustainability and ownership.

Keywords: Infection prevention and control • Health systems strengthening • WHO hand hygiene improvement strategy • Hand hygiene audit • Hand hygiene compliance • Hand hygiene self-assessment framework • Hospital IPC level • Hand hygiene level • Infection Prevention and Control Assessment Framework • Core components of IPC programmes • Alcohol-based handrub • Handwashing basin • Healthcare-associated infections • Community engagement

Introduction

The current 2018-2020 outbreak in eastern DRC started with four cases who had tested positive for EVD in the eastern region of Kivu in the DRC [1-3]. This is the tenth epidemic of EVD in the Democratic Republic of the Congo and it was declared by the Ministry of Health on 1 August 2018. The outbreak is centred in the northeast of the country, in North Kivu and Ituri provinces. The number of cases having surpassed 3,400, it is the country's largest Ebola

outbreak. It is also the second-biggest Ebola epidemic ever recorded, behind the West Africa outbreak of 2014-2016. On 14 July 2019, the first case of Ebola was confirmed in Goma, the capital of North Kivu, and a city of one million people. On 30 July 2019, a second person in Goma was diagnosed with Ebola, he died the next day and two more cases were announced from the same family. In reaction to the first case found in Goma, on 17 July 2019, the World Health Organization (WHO) announced that the current Ebola outbreak in DR Congo represents a public health emergency of international concern (PHEIC). In mid-August 2019, the epidemic spread to neighbouring South Kivu province, and it became the third province in DRC to record cases in the ongoing outbreak and the cases have been found in Mwenga, 100 kilometres from Bukavu, the capital of the province. The national laboratory (INRB) confirmed on 7 August 2018 that the current outbreak is of the Zaire Ebola virus, the deadliest strain and the same one that affected West Africa during the 2014-2016 outbreak.

The International Health Regulation (2005) gives significant weight to Infection Prevention and Control as a central strategy for dealing with public health threats of international concern [4]. Improving IPC and hand hygiene

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through multimodal strategies implementation reduce healthcare-associated infections (HAI) rates including EVD [5,6]. Failure to perform appropriate hand hygiene is considered to be the leading cause of HAI and the spread of multi-resistant organisms, and has been recognized as a significant contributor to outbreaks [5].

Transmission of healthcare-associated pathogens through contaminated HCWs' hands is the most common pattern in most settings and require five sequential steps: (i) organisms are present on the patient's skin, or have been shed onto inanimate objects immediately surrounding the patient; (ii) organisms must be transferred to the hands of HCWs; (iii) organisms must be capable of surviving for at least several minutes on HCWs' hands; (iv) handwashing or hand antisepsis by the HCWs must be inadequate or omitted entirely, or the agent used for hand hygiene inappropriate; and (v) the contaminated hand or hands of the caregiver must come into direct contact with another patient or with an inanimate object that will come into direct contact with the patient [5-7]. Adherence of healthcare workers (HCW) to recommended hand hygiene procedures has been reported as variable, with mean baseline rates ranging from 5% to 89% and an overall average of 38.7% [12]. Defective hand cleansing (e.g. use of an insufficient amount of product and/or an insufficient duration of hand hygiene action) leads to poor hand decontamination. Obviously, when HCWs fail to clean their hands during the sequence of care of a single patient and/or between patients' contact, microbial transfer is likely to occur. Contaminated HCWs' hands have been associated with endemic HAIs and also with several HAI outbreaks [8-10]. The aim of this study was to evaluate whether the implementation of infection prevention and control programme in healthcare facilities improves the level of EVD preparedness and response.

The infection Prevention and Control programme consists of eight core components that require to be implemented in each acute healthcare facility, especially in each hospital [11-15]. Those core components are:

(1) **Setting up IPC programme** with a dedicated, trained team should be in place in each acute health care facility for the purpose of preventing healthcare-associated infections (HAI) and combating antimicrobial resistance (AMR) through IPC good practices, Stand-alone, active national IPC programmes with clearly defined objectives, functions and activities for the purpose of preventing HAI and combating AMR through IPC good practices should be established. National IPC programmes should be linked to other relevant national programmes and professional organizations.

(2) **Evidence-based guidelines:** Evidence-based guidelines should be developed and implemented for the purpose of reducing HAI and AMR. Education and training of the relevant health care workers on guideline recommendations and monitoring of adherence with guideline recommendations should be undertaken to achieve successful implementation.

(3) **Education and Training:** At the facility level, IPC education should be in place for all health care workers by utilizing team and task-based strategies that are participatory and include bedside and simulation training to reduce the risk of HAI and AMR. The national IPC programme should support education and training of the health workforce as one of its core functions.

(4) **Surveillance:** Facility-based HAI surveillance should be performed to guide IPC interventions and detect outbreaks, including AMR surveillance with timely feedback of results to health care workers and stakeholders and through national networks. National HAI surveillance programmes and networks that include mechanisms for timely data feedback and with the potential to be used for benchmarking purposes should be established to reduce HAI and AMR.

(5) **Multimodal strategies:** At the facility level, IPC activities should be implemented using multimodal strategies to improve practices and reduce HAI and AMR. National IPC programmes should coordinate and facilitate the implementation of IPC activities through multimodal strategies at the national or sub-national level.

(6) **Monitoring, audit and feedback:** Regular monitoring/audit and timely feedback of health care practices should be undertaken according to IPC standards to prevent and control HAIs and AMR at the health care facility level. Feedback should be provided to all audited persons and relevant staff.

A national IPC monitoring and evaluation programme should be established to assess the extent to which standards are being met and activities are being performed according to the programme's goals and objectives. Hand hygiene monitoring with feedback should be considered as a key performance indicator at the national level.

(7) **Workload, staffing and bed occupancy:** In order to reduce the risk of HAI and the spread of AMR, the following should be addressed: (a) bed occupancy should not exceed the standard capacity of the facility; (b) health care worker staffing levels should be adequately assigned according to patient workload.

(8) **Built environment, materials and equipment:** At the facility level, patient care activities should be undertaken in a clean and/or hygienic environment that facilitates practices related to the prevention and control of HAI, as well as AMR, including all elements around the water, sanitation and hygiene (WASH) infrastructure and services and the availability of appropriate IPC materials and equipment. At the facility level, materials and equipment to perform appropriate hand hygiene should be readily available at the point of care [11-14].

The Multimodal Hand Hygiene Improvement Strategy consists of five key elements that are (1) system change to ensure access of healthcare workers to hand hygiene facilities with emphasis on availability of alcohol-based hand rub (ABHR) formulations at the point of care, (2) ongoing training and education, (3) evaluation of practices and feedback, (4) reminders at the workplace, and (5) providing a climate of safety through institution [12].

Methods

This quasi-experimental intervention study was conducted in ten hospitals of Goma EVD sub coordination, North-Kivu Province between April and October 2019. We implemented Infection Prevention and Control Programme as defined by World Health Organization in its recently published Guidelines on core components of IPC programmes at the acute health care facility level in the 10 following hospitals: North Kivu Provincial Hospital, Heal Africa Hospital, Charité Maternelle General Reference Hospital, Kyeshero Hospital, Virunga General Reference Hospital, Goma Regional Military Hospital, Kirotshe General Reference Hospital, Rutshuru General Reference Hospital and Pinga General Reference Hospital. Our focus was the implementation of WHO's Multimodal Hand Hygiene Improvement Strategy in each hospital. The entire project included five steps: (1) facility preparedness, (2) baseline evaluation, (3) implementation, (4) follow-up evaluation, and (5) ongoing planning and review cycle [12].

The main activities were the following: baseline assessment of infection prevention and control programme, baseline assessment of hand hygiene programme, baseline assessment of hand hygiene practices (direct observation) for frontline healthcare workers, setting up hospital Infection prevention and control committee and nomination of hospital infection prevention and control focal point, briefing of the IPC committee members and IPC focal point on their roles and responsibilities, a 5 day IPC training workshop for hospital senior managers, IPC committee members and IPC focal point. The training emphasized on basic IPC, leadership and management of IPC programme. At the end of the training, the Medical director of each hospital signed a pledge to own and sustain IPC programme. We also organized a five (5) day IPC training workshop for frontline healthcare workers focusing on basic infection prevention and control considering both Ebola and usual contexts. We, then organized a three (3) day infection prevention and control training workshop for healthcare facility hygienists. The training took into account three contexts (usual, Ebola and Cholera). The first day is devoted to theory, the second day focuses on practical sessions. The third day is devoted to internships in healthcare facilities. Each hospital received IPC kit composed by IPC equipment, materials and supplies including consumables. A supportive supervision with well-trained IPC supervisors was established whereby coaching and mentorship methods were used to help trained healthcare workers translate their knowledge into practice.

The assessment of IPC programme was conducted using WHO Infection Prevention and Control assessment framework at the facility level [14], WHO hand hygiene self-assessment framework 2010 [16] was used to assess hand hygiene programme, and WHO direct observation form [17] used to evaluate hand hygiene practices among healthcare workers in different in-patient wards. Well-trained IPC supervisors who demonstrated competencies in performing hand hygiene direct observation of practices conducted the observation of hand hygiene practices in different in-patient wards. A two days training workshop was organized to each hospital IPC committee members, IPC focal point and other senior hospital clinical managers and it was made of 2 sessions. The first session consisted with theoretical knowledge transfer, whereby WHO's training Power Point slides for observers were taught during a period of one day and it covered WHO Multimodal Hand Hygiene Improvement Strategy and direct observation of hand hygiene practices. The second session was the practical exercises to enable trainees to develop skills on how to conduct both hand hygiene self-assessment of the hospital and how to conduct hand hygiene audit by using direct observation method.

The WHO's direct observation form is based on "My Five Moments for hand hygiene" that consists of the following: before patient contact, before aseptic procedure, after body fluid exposure risk, after patient contact, and after contact with patient surroundings as hand hygiene indications [6]. A positive or negative HH action, whether hand washing or hand rubbing, was recorded provided that it related to an indication. Opportunity is defined as the time hand hygiene should happen and it must relate to at least one hand hygiene indication. The compliance is calculated by dividing positive actions by opportunities. Hand hygiene practice of healthcare workers was monitored in 60-minute sessions. All categories of HCWs present in a ward at the time of the audit were observed for hand hygiene practice. These included nurses, doctors, Allied Health Professionals and Auxiliaries including Hygienists and cleaners. Performance feedback was given to the In-charges and Managers in each in-patient ward at the completion of the audit and a final report was consolidated and a power point presentation prepared and presented to the hospital management, heads of departments, heads of services and in-charges. Table-round discussions were held in each hospital and an improvement plan developed.

The improvement program was implemented. Infection prevention and control (IPC) kit was provided to each hospital. The composition of IPC kit is as follows: Personnel Protective Equipment (nitrile clinical examination gloves, nitrile domestic gloves, surgical three layers surgical masks, plastic apron, flexible or rigid goggles, plastic boots, plastic eye-shields, fluid-resistant coveralls, hoods, N-95 respirators and surgical water-proof gowns); hand hygiene consumables (alcohol-based handrub sanitizers 1 litre and 100 ml bottles, liquid soap 500 ml bottles, 20 litres handwashing basins devices, disposable paper towels); triage materials (plastic table, plastic chairs, thermoflash, umbrellas); waste management supplies (plastic bins, plastic bin liners, biosafety boxes, burners/ Montfort incinerators), supplies for environmental cleaning (powder soap, chlorine HTH 70%, dosing spoon for chlorine, 135 litre plastic container for mixing chlorine, sprayers), reminders at the workplace (different posters such hand washing, hand rubbing, EVD case definitions, triage and isolation, EVD transmission, waste segregation, waste disposal, injection safety). Visual hand hygiene colour posters in different sizes were provided that showed the five moments for hand hygiene and right techniques. Posters were placed in the most visible places in wards (in front of nursing stations) and next to each handwashing basin (poster for hand washing).

The impact assessment was conducted 6 months later (after the intervention period). A hospital-wide roundtable presentation of the results, discussion on how to address the gaps and improvement plan has been organized in each of the ten hospitals. Data was analyzed using Ms Excel.

Results

The baseline assessment of IPC and hand hygiene programmes was conducted in each of the above-mentioned ten hospitals in North-Kivu in

DRC between April and May 2019. The results from IPC programme baseline assessment demonstrated that 8 out 10 (80%) hospitals were at inadequate level, 2 out of 10 (20%) hospitals were at basic level (Table 1). None of the 10 (0%) hospitals were at intermediate nor advanced level. When looking at each core component, lower performance was observed on the following core components: Core component no 2 (IPC guidelines), core component no 4 (surveillance of healthcare-associated infections), core component no 5 (multimodal strategies for implementing of IPC interventions, and the core component no 6 (Monitoring/audits of IPC practices and feedback) (Table 1). For hand hygiene programme, 80% (8/10) hospitals were at inadequate level while 20% (2/10) hospitals were at basic level (Table 2). When looking at each hand hygiene strategy, lower performance was observed on the following strategies: strategy no 2 (Training and education), strategy no 3 (Evaluation and feedback), strategy no 5 (Institutional safety climate for hand hygiene) (Table 2). Overall hand hygiene compliance among healthcare professionals was 33.1% (898/2713) (Tables 3 and 4). In terms of five moments for hand hygiene, the compliance was: Before touching patient: 35.5% (289/814), before clean/aseptic procedure: 37.7% (116/308), after body fluid exposure: 44.4% (91/205), after touching patient: 38.7% (273/705), after touching patient surrounding: 18.9% (129/681) (Table 5). Hand hygiene practice by categories of healthcare professionals was: medical doctors: 45.0% (514/1141), nurses and midwives: 28.3% (296/1047), medical students: 19.8% (25/126), nursing students: 16.0% (59/369), physiotherapists: 40.0% (2/5), radiology technicians: 0.0% (0/1), intern nutritionists: 10.0% (1/10), nutritionists: 12.5% (1/8), hygienists: 0.0% (0/6) (Table 4). Hand hygiene practice per in-patient ward was the following: Surgical: 34.8% (117/336), Emergencies: 17.1% (49/287), Paediatrics: 33.2% (182/549), ICU: 25.2% (51/202), Neonatology: 39.6% (40/101), Internal medicine: 46.9% (201/429), Gynaeco-obstetrics: 30.8% (143/464), Clinic: 31.8% (35/110), Outpatient consultation: 33.1% (59/178), Resuscitation: 36.8% (21/57) (Table 6). Hand hygiene compliance by hospital was: HOPITAL PROVINCIAL DU NORD KIVU: 28.9% (152/526), HGR CHARITE MATERNELLE: 31.3% (121/387), HGR NYIRAGONGO: 50.0% (53/106), HOPITAL MILITAIRE REGIONAL DE GOMA: 12.2% (18/148), HOPITAL HEAL AFRICA: 43.1% (93/216), HGR VIRUNGA: 34.5% (89/258), HGR RUTSHURU: 42.7% (253/593), HOPITAL KYESHERO: 34.9% (80/229), HGR KIOTSHE: 15.5% (39/252), HGR PINGA: 0.0% (there was no water nor alcohol-based handrub available during the baseline assessment) (Table 6).

The impact/post intervention assessment for both IPC and hand hygiene programmes was conducted in October 2019. Both programmes improved significantly in each hospital. 10 hospitals improved IPC programme from inadequate level (8 hospitals) and basic level (2 hospitals) to intermediate level. None of these hospitals achieved advanced level (Tables 7 and 8). The following core components require more attention in the future: Healthcare-associated infections (HAI) surveillance, workload, staffing and bed occupancy as well as Built environment, materials and equipment for IPC at the facility level. For hand hygiene programme, all the 10 hospitals made a significant improvement as well. 4 hospitals achieved advanced level (HGR CHARITE MATERNELLE, HOPITAL HEAL AFRICA, HGR VIRUNGA, HOPITAL KYESHERO), 5 hospitals achieved intermediate level (HOPITAL PROVINCIAL DU NORD KIVU, HGR NYIRAGONGO, HOPITAL MILITAIRE REGIONAL DE GOMA, HGR RUTSHURU, HGR KIOTSHE), while HGR Pinga achieved basic level (Tables 8 and 9). All the strategies require more attention, most importantly the strategy no 5 (Institutional safety climate for hand hygiene). There is a need to engage patients and community in hand hygiene programme. Hand hygiene should become a habit and be considered as the most effective method in the prevention of infections.

The findings from direct observation of hand hygiene practice among healthcare professionals conducted in October 2019 as a measurement of impact of the intervention demonstrated a significant improvement in terms of hand hygiene practice. 4368 hand hygiene actions over 6197 hand hygiene opportunities were observed in the 10 hospitals and the overall compliance of hand hygiene practice was 70.5% (Table 10). When looking at the five moments for hand hygiene in clinical settings, the compliance was: Before touching patient: 81.1% (1505/1855), before clean/aseptic procedure: 92.8% (874/942), after body fluid exposure: 94.0% (455/484), after touching patient: 69.2% (1039/1501), after touching patient surrounding: 35.0%

Table 1: Baseline assessment of IPC programme in 10 hospitals in North-Kivu Province, DRC: April - May 2019.

Assessment of Infection Prevention and Control (IPC) programme in hospitals		Hopital Provincial Du Nord Kivu	Hgr Charite Maternelle	Hopital Heal Africa	Hgr Nyiragongo	Hopital Militaire Regional De Goma	Hgr Virunga	Hopital Kyeshero	Hgr Pinga	Hgr Rutshuru	Hgr Kirotshe
No	Core component	Subtotal/100	Subtotal/100	Subtotal/100	Subtotal/100	Subtotal/100	Subtotal/100	Subtotal/100	Subtotal/100	Subtotal/100	Subtotal/100
1	Infection Prevention and Control (IPC) programme	22.5	0	42.5	25	17.5	30	45	0	40	35
2	Infection Prevention and Control (IPC) guidelines	40	17.5	20	2.5	2.5	12.5	0	0	0	0
3	Infection Prevention and Control (IPC) education and training	25	10	25	20	10	20	20	10	20	20
4	Health care-associated infection (HAI) surveillance	47.5	30	10	0	0	0	0	0	0	0
5	Multimodal strategies for implementation of infection prevention and control (IPC) interventions	15	0	0	0	0	5	0	0	0	0
6	Monitoring/ audits of IPC practices and feedback	20	0	25	0	0	15	0	0	0	0
7	Workload, staffing and bed occupancy	50	50	40	45	50	45	55	35	15	25
8	Built environment, materials and equipment for IPC at the facility level	62.5	40	75	40	40	55	55	20	62.5	32.5
Final total score		282.5/800	147.5/800	237.5/800	132.5/800	120/800	182.5/800	175/800	65/800	137.5/800	112.5/800
Hospital IPC level		Basic	Inadequate	Basic	Inadequate	Inadequate	Inadequate	Inadequate	Inadequate	Inadequate	Inadequate

Table 2: Baseline assessment of hand hygiene programme in 10 hospitals in North-Kivu Province, DRC: April - May 2019.

Assessment of Hand Hygiene programme in hospitals		Hopital Provincial Du nord kivu	Hgr Charite Maternelle	Hopital Heal Africa	Hgr Nyiragongo	Hopital Militaire Regional De Goma	Hgr Virunga	Hopital Kyeshero	Hgr Pinga	Hgr Rutshuru	Hgr Kirotshe
No	Component	Subtotal/100	Subtotal/100	Subtotal/100	Subtotal/100	Subtotal/100	Subtotal/100	Subtotal/100	Subtotal/100	Subtotal/100	Subtotal/100
1	System Change	80	50	45	50	0	50	15	0	70	25
2	Training and Education	0	15	0	0	0	0	0	0	0	0
3	Evaluation and Feedback	0	0	0	0	0	0	0	0	0	0
4	Reminders in the Workplace	50	40	32.5	25	25	30	15	0	25	35
5	Institutional Safety Climate for Hand Hygiene	20	25	15	15	0	15	20	0	20	0
TOTAL		150/500	130/500	92.5/500	90/500	25/500	95/500	50/500	0/500	115/500	60/500

Hand Hygiene Level for the hospital	Basic	Basic	Inadequate	Inadequate	Inadequate	Inadequate	Inadequate	Inadequate	Inadequate	Inadequate
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Table 3: Baseline and impact assessments of hand hygiene practices in 10 hospitals of North-Kivu Province, DRC by five moments of hand hygiene in clinical settings: April - May 2019 and October 2019.

Hospital	Baseline Assessment			Impact Assessment		
	#Opportunities	#Actions	Compliance (%)	#Opportunities	#Actions	Compliance (%)
HOPITAL PROVINCIAL DU NORD KIVU	525	152	29.0	1211	875	72.3
HGR CHARITE MATERNELLE	387	121	31.3	649	535	82.4
HGR NYIRAGONGO	106	53	50.0	371	268	72.2
HOPITAL MILITAIRE REGIONAL DE GOMA	148	18	12.2	632	382	60.4
HOPITAL MILITAIRE REGIONAL DE GOMA	216	93	43.1	599	454	75.8
HGR VIRUNGA	258	89	34.5	419	299	71.4
HGR RUTSHURU	592	253	42.7	957	741	77.4
HOPITAL KYESHERO	229	80	34.9	614	381	62.1
HGR KIROTSHE	252	39	15.5	457	234	51.2
HGR PINGA	0	0	0.0	288	199	69.1
TOTAL	2713	898	33.1	6197	4368	70.5

Table 4: Summary of hand hygiene practice from the direct observation conducted in 10 hospitals in North-Kivu Province in DRC from April to May 2019 and October 2019, by categories of healthcare professionals.

Profession, Category	Baseline Assessment			Impact Assessment		
	#Opportunities	#Actions	Compliance (%)	#Opportunities	#Actions	Compliance (%)
Medical Doctors	1141	514	45.0	2507	2010	80.2
Nurses/Midwives	1047	296	28.3	2202	1751	79.5
Medical Students	126	25	19.8	432	175	40.5
Nursing Students	369	59	16.0	816	317	38.8
Physiotherapist	5	2	40.0	48	34	70.8
Radiology Technicians	1	0	0.0	0	0	0.0
Intern Nutritionists	10	1	10.0	34	14	41.2
Nutritionists	8	1	12.5	51	43	84.3
Hygienists	6	0	0.0	107	24	22.4
Total	2713	898	33.1	6197	4368	70.5

Table 5: Summary of hand hygiene practice from the direct observation conducted in 10 hospitals in North-Kivu Province in DRC from April to May 2019 and October 2019, by five moments of hand hygiene.

Moments	Baseline Assessment			Impact Assessment		
	#Opportunities	#Actions	Compliance (%)	#Opportunities	#Actions	Compliance (%)
Before Touching Patient	814	289	35.5	1855	1505	81.1
Before Clean/Aseptic Procedure	308	116	37.7	942	874	92.8
After Body Fluid Exposure	205	91	44.4	484	455	94.0
After Touching Patient	705	273	38.7	1501	1039	69.2
After Touching Patient Surrounding	681	129	18.9	1415	495	35.0
Total	2713	898	33.1	6197	4368	70.5

Table 6: Summary of hand hygiene practice from the direct observation conducted in 10 hospitals in North-Kivu Province in DRC from April to May 2019 and October 2019, by in-patient ward.

Ward	Baseline Assessment			Impact Assessment		
	#Opportunities	#Actions	Compliance (%)	#Opportunities	#Actions	Compliance (%)
Surgical	336	117	34.8	1021	706	69.1
Emergencies	287	49	17.1	560	311	55.5
Paediatrics	549	182	33.2	1260	917	72.8
Intensive Care Unit (ICU)	202	51	25.2	356	317	89.0
Neonatology	101	40	39.6	303	255	84.2
Internal Medicine	429	201	46.9	970	674	69.5
Gynaeco-Obstetrics	464	143	30.8	1076	738	68.6
Clinic	110	35	31.8	290	201	69.3
Outpatient Consultation	178	59	33.1	286	185	64.7

Resuscitation	57	21	36.8	75	64	85.3
Total	2713	898	33.1	6197	4368	70.5

Table 7: Impact assessment of IPC programme implemented in 10 hospitals in North-Kivu Province in DRC: October 2019.

Assessment of Infection Prevention and Control (IPC) programme in hospitals		Hopital Provincial Du Nord Kivu	Hgr Charite Maternelle	Hopital Heal Africa	Hgr Nyiragongo	Hopital Militaire Regional De Goma	Hgr Virunga	Hopital Kyeshero	Hgr Pinga	Hgr Rutshuru	Hgr Kirotshe
No	Core component	Subtotal/100	Subtotal/100	Subtotal/100	Subtotal/100	Subtotal/100	Subtotal/100	Subtotal/100	Subtotal/100	Subtotal/100	Subtotal/100
1	Infection Prevention and Control (IPC) programme	80	85	67.5	67.5	67.5	57.5	67	67.5	57.5	67.5
2	Infection Prevention and Control (IPC) guidelines	95	87.5	85	82.5	85	85	82.5	82.5	82.5	82.5
3	Infection Prevention and Control (IPC) education and training	90	95	85	85	85	80	80	85	85	85
4	Health care-associated infection (HAI) surveillance	10	12.5	22.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5
5	Multimodal strategies for implementation of infection prevention and control (IPC) interventions	85	90	75	90	85	80	90	90	90	90
6	Monitoring/ audits of IPC practices and feedback	97.5	95	95	70	80	90	75	75	80	75
7	Workload, staffing and bed occupancy	55	45	55	40	35	40	60	40	10	40
8	Built environment, materials and equipment for IPC at the facility level	82.5	82.5	82.5	50	52.5	85	76	61	70	65
Final total score		595/800	592.5/800	567.5/800	492.5/800	497.5/800	525/800	538/800	508.5/800	482.5/800	512.5/800
Hospital IPC level		Intermediate	Intermediate	Intermediate	Intermediate	Intermediate	Intermediate	Intermediate	Intermediate	Intermediate	Intermediate

Table 8: Comparison of the findings from the baseline and impact assessment of IPC and hand hygiene programmes in 10 hospitals in North-Kivu, DRC.

Level of the programme	IPC programme		Hand Hygiene Programme	
	Baseline Assessment (April-May 2019)	Impact Assessment (October 2019)	Baseline Assessment (April-May 2019)	Impact Assessment (October 2019)
	#Hospitals	#Hospitals	#Hospitals	#Hospitals
Inadequate	8	0	8	0
Basic	2	1	2	1
Intermediate	0	5	0	5
Advanced	0	4	0	4

Table 9: Impact assessment of hand hygiene programme implemented in 10 hospitals in North-Kivu Province in DRC: October 2019.

Assessment of Hand Hygiene programme in hospitals		Hopital Provincial Du Nord Kivu	Hgr Charite Maternelle	Hopital Heal Africa	Hgr Nyiragongo	Hopital Militaire Regional De Goma	Hgr Virunga	Hopital Kyeshero	Hgr Pinga	Hgr Rutshuru	Hgr Kirotshe
No	Component	Subtotal/100	Subtotal/100	Subtotal/100	Subtotal/100	Subtotal/100	Subtotal/100	Subtotal/100	Subtotal/100	Subtotal/100	Subtotal/100
1	System Change	90	90	100	80	80	100	100	65	80	60
2	Training and Education	90	90	90	80	80	90	90	35	80	80
3	Evaluation and Feedback	65	70	70	65	60	80	70	60	65	65
4	Reminders in the Workplace	65	85	65	60	60	65	65	32.5	65	60
5	Institutional Safety Climate for Hand Hygiene	60	70	70	55	55	60	60	35	55	35
TOTAL		370/500	405/500	395/500	340/500	335/500	395/500	385	227.5/500	345/500	300/500
Hand Hygiene Level for the hospital		Intermediate	Advanced	Advanced	Intermediate	Intermediate	Advanced	Advanced	Basic	Intermediate	Intermediate

Table 10: Situational analysis of hand hygiene procedures during baseline and impact assessment of hand hygiene practice from the direct observation conducted in 10 hospitals in North-Kivu Province in DRC during April and May 2019 and October 2019.

Hospital	Baseline assessment						Impact assessment					
	Total Actions	HW		ABHR		Total Actions	HW		ABHR		Total Actions	Total Actions
		#Actions	%	#Actions	%		#Actions	%	#Actions	%		
HOPITAL PROVINCIAL DU NORD KIVU	152	62	40.8	90	59.2	875	114	13.0	761	87.0		
HGR CHARITE MATERNELLE	121	72	59.5	49	40.5	535	79	14.8	456	85.2		
HGR NYIRAGONGO	53	23	43.4	30	56.6	268	31	11.6	237	88.4		
HOPITAL MILITAIRE REGIONAL DE GOMA	18	8	44.4	10	55.6	382	37	9.7	345	90.3		
HOPITAL MILITAIRE REGIONAL DE GOMA	93	44	47.3	49	52.7	454	46	10.1	408	89.9		
HGR VIRUNGA	89	40	44.9	49	55.1	299	69	23.1	230	76.9		
HGR RUTSHURU	253	120	47.4	133	52.6	741	140	18.9	601	81.1		
HOPITAL KYESHERO	80	33	41.3	47	58.8	381	76	19.9	305	80.1		
HGR KILOTSHE	39	12	30.8	27	69.2	234	60	25.6	174	74.4		
HGR PINGA	0	0	0.0	0	0.0	199	50	25.1	149	74.9		
TOTAL	898	414	46.1	484	53.9	4368	702	16.1	3666	83.9		

(495/1415) (Table 5). Hand hygiene practice among categories of healthcare professionals was: medical doctors: 80.2% (2010/2507), nurses and midwives: 79.5% (1751/2202), medical students: 40.5% (175/432), nursing students: 38.8% (317/816), physiotherapists: 70.8% (34/48), intern nutritionists: 41.2% (14/34), nutritionists: 84.3% (43/51), hygienists: 22.4% (24/107) (Table 4). Hand hygiene practice per in-patient ward was: Surgical: 69.1% (706/1021 opportunities), Emergencies: 55.5% (311/560), Paediatrics: 72.8% (917/1260), ICU: 89.0% (317/356), Neonatology: 84.2% (255/303), Internal medicine: 69.5% (674/970), Gynaeco-obstetrics: 68.6% (738/1076), Clinic: 69.3% (201/290), Outpatient consultation: 64.7% (185/286), Resuscitation: 85.3% (64/75) (Table 6). When looking at the hospital level, hand hygiene compliance was: HOPITAL PROVINCIAL DU NORD KIVU: 72.3% (875/1211), HGR CHARITE MATERNELLE: 82.4% (535/649), HGR NYIRAGONGO: 72.2% (268/371), HOPITAL MILITAIRE REGIONAL DE GOMA: 60.4% (382/632), HOPITAL HEAL AFRICA: 75.8% (454/599), HGR VIRUNGA: 71.4% (299/419), HGR RUTSHURU: 77.4% (741/957), HOPITAL KYESHERO: 62.1% (381/614), HGR KILOTSHE: 51.2% (234/457), HGR PINGA: 69.1% (199/288) (Table 10). When looking at procedures of hand hygiene procedure (washing hands with soap and water or chlorine solution 0.05% and alcohol-based handrub): before intervention handwashing with soap and water or chlorine

0.05% solution represented 38.1% of all hand hygiene performed actions and alcohol-based handrub (ABHR) was 61.9% (Table 10). After intervention, handwashing practice represented 16.1% while ABHR represented 83.9% of all hand hygiene performed actions (Table 10). Making available readily-accessible alcohol-based handrub solution (ABHR) at the point of care, posting hand washing veronica buckets in all in-patient wards and clinical areas, and regularly filling them with clean water and regularly supply of liquid soap, hand towels and posters for reminding for hand hygiene action coupled to the training of all categories of healthcare professionals helped in improving hand hygiene practice from 33.1% to 70.5%.

Discussion

The results of this study demonstrated the importance of infection prevention and control programme in improving quality of healthcare delivery and strengthening health system in general. In the context of DRC, implementation of both infection prevention and control and hand hygiene programmes helped in defeating EVD, particularly in the area of Goma where those programmes have been implemented in early 2019. The first

and the second cases of EVD in Goma were well controlled and there were neither secondary cases nor EVD nosocomial infections. When looking at the improvement made for both programmes, all the 10 hospitals achieved intermediate level of Infection prevention and control programme from inadequate (8 hospitals) and basic (2 hospitals) levels. All the hospitals improved their hand hygiene programme as well. Four hospitals achieved advanced level, five hospitals achieved intermediate level and one hospital achieved basic level. There was a significant improvement in terms of hand hygiene practice. Overall, hand hygiene compliance improved from 33.1% (898 actions over 2713 opportunities) to 70.5% (4368 actions over 6197 opportunities) with improvement of 37.4%. When looking at the hospital level, each of the 10 hospitals improved its hand hygiene compliance. HOSPITAL PROVINCIAL DU NORD KIVU made an improvement of 43.3% that means from 29.0% to 72.3%, HGR CHARITE MATERNELLE improved from 31.3% to 82.4% with an improvement of 51.1%, HGR NYIRAGONGO improved from 50.0% to 72.2% with an improvement of 22.2%, HOSPITAL MILITAIRE REGIONAL DE GOMA improved from 12.2% to 60.4% with an improvement of 48.2%, HOSPITAL HEAL AFRICA improved from 43.1% to 75.8% with an improvement of 32.7%, HGR VIRUNGA improved from 34.5% to 71.4% with an improvement of 36.9%, HGR RUTSHURU improved from 42.7% to 77.4% with an improvement of 34.7%, HOSPITAL KYESHERO improved from 34.9% to 62.1% with an improvement of 27.9%, HGR KIOTSHE improved from 15.5% to 51.2% with an improvement of 35.7%, HGR PINGA improved from 0.0% to 69.1% with an improvement of 69.1% (Table 6). Some IPC core components such as setting up IPC programme, IPC guidelines, IPC training and education, multimodal strategies for implementation of IPC interventions, monitoring of IPC practices and feedback, were likely to be easy for implementation with local resources whereby others such as healthcare-associated infections (HAI) surveillance, workload, staffing and bed occupancy, built environment, materials and equipment for IPC at the facility level required more expertise and more resources.

In terms of hand hygiene programme, the components such as system change, training and education, evaluation and feedback, reminders in the workplace were easy for implementation at the facility level. The strategy no 5 (institutional safety climate for hand hygiene) was the likely to be more difficult for implementation.

Conclusion

The best way to combat outbreaks including Ebola virus disease (EVD) in any country is to strengthen its health systems with more focus on Infection Prevention and Control (IPC) programme and hand hygiene in particular. The implementation of both IPC and hand hygiene programmes in healthcare facilities in North-Kivu Province in DRC proved the importance of putting more effort on working on the programme including setting up of the IPC programme in the light of the local context. Multimodal strategies remain the best way to be based on when implementing any programme. IPC level in 10 hospitals improved from inadequate level (80%) to intermediate level (100%). Hand hygiene level in 10 hospitals improved from inadequate level (80%) to advanced level (40%), intermediate level (50%) and basic level (10%). Hand hygiene practices among healthcare professionals improved significantly from 33.1% to 70.5%. Medical doctors and nurses/midwives improved their hand hygiene performance from 45.0% to 80.2% for medical doctors and from 28.3% to 79.5% for nurses/midwives. Low hand hygiene performance continued to be noted among students (medical and nursing) population, where it improved from 19.8% to 40.5% for medical students and from 16.0% to 38.8% for nursing students. Universities and higher education institutions should integrate IPC and Hand hygiene programmes in the pre-service healthcare teaching curricula.

More efforts, resources and expertise are required for better implementation of IPC programme, especially for the core components such as Healthcare-associated infections (HAI) surveillance, workload, staffing and bed occupancy as well as Built environment, materials and equipment for IPC at the facility level.

There is a need to engage patients and communities in hand hygiene programme. Hand hygiene should be considered as very important and become a habit. For healthcare professionals it should become a second nature as well as

for the community members. Hand hygiene remains the cheap and most effective method in the prevention of infectious diseases and outbreaks.

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