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Healthcare workers' training and information levels over an occupationally acquired Ebola virus disease

Training und Informationslevel von medizinischem Personal: Arbeitsbedingte Ebolainfektionen

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Abstract

Background: Hundreds of West African healthcare workers (HCW) have become ill with Ebola virus disease (EVD) and died during the recent outbreak. The occurrence of occupational infections in laboratories could be due to the lack of use of personal protective equipment, the failure to implement specific regulations about the use of equipment and how to work with hazardous materials. Our study attempted to assess the information as well as training level of HCW of a German high level isolation unit and their concern over an occupationally acquired EVD.

Methods: During the recent Ebola virus outbreak a survey was conducted among HCWs, using an anonymous questionnaire.

Results: Although 70% of our total study population stated that they have all the information needed to care

for Ebola patients, only 18.2% of laboratory workers and 29.4% of the HCW of the virology department felt sufficiently trained. The HCW rated the Internet (64.3%) and the daily press (54.3%) as the most important sources of information. Medical literature (45.7%) and official institutions (40.4%) were rated less often.

Conclusions: Formulated pointedly, the HCW turned to popular science to get the information they need to feel safe. Further in house training regarding practical skills and reference to scientific literature would be a better solution to ensure workplace safety.

Keywords: Ebola; healthcare personnel; healthcare worker; laboratory worker; occupational infections.

Zusammenfassung

Einleitung: Während des Ebolaausbruchs in West Afrika erkrankten und verstarben mehrere hundert medizinische Beschäftigte an Ebolainfektionen. Arbeitsbedingte Infektionen in Laboratorien können beispielsweise durch die fehlende Verwendung von persönlicher Schutzausrüstung sowie durch das Versäumnis die Arbeitsabläufe im Umgang mit gefährlichen Arbeitsstoffen zu regeln, auftreten. Ziel unserer Studie war den Informations- und Trainingslevel sowie die Besorgnis hinsichtlich einer arbeitsbedingten Ebolainfektion von medizinischen Beschäftigten eines Behandlungszentrums für hochkontagiöse und lebensbedrohliche Erkrankungen zu erheben.

Methoden: Zum Zeitpunkt des Höhepunkts der Ebolaepidemie führten wir eine anonyme Fragebogenerhebung bei medizinischen Beschäftigten durch.

Ergebnisse: Wenngleich 70% des Studienkollektivsangaben über genügend Informationen zu verfügen um

Article note: In memory of all the healthcare workers who lost their lives in their fight against Ebola.

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Ebolapatienten zu betreuen, fühlten sich nur 18,2% des Laborpersonals und nur 29,4% der Beschäftigten des Instituts für Medizinische Virologie ausreichend geschult. Internet (64,3%) und Tageszeitung (54,3%) wurden als wichtigste Informationsquelle genannt. Medizinische Fachliteratur (45,7%) und Informationen von offiziellen Institutionen (40,4%) wurden deutlich seltener verwandt. **Schlussfolgerungen:** Pointiert ausgedrückt, verwendeten medizinische Beschäftigte populärwissenschaftliche Texte um sich die Informationen zu verschaffen um sich sicher zu fühlen. Intensives Training am Arbeitsplatz hinsichtlich praktischer Fähigkeiten und das Studium der Fachliteratur wären jedoch eine bessere Lösung um die Arbeitsplatzsicherheit zu gewährleisten.

Schlüsselwörter: arbeitsbedingte Infektionen; Ebola; Laborpersonal; medizinische Beschäftigte; medizinisches Personal.

Introduction

On August 8, 2014 the World Health Organization (WHO) has declared the recent outbreak of Ebola virus disease (EVD) a public health emergency of international concern. The outbreak is the largest, most severe and most complex EVD outbreak ever recorded. As of July 1, 2015 Guinea, Liberia and Sierra Leone have reported 27514 cases, including 11220 deaths [1].

In December 2014 the *Time* magazine has chosen Ebola fighters as Person of the year 2014: “For tireless acts of courage and mercy, for buying the world time to boost its defenses, for risking, for persisting, for sacrificing and saving” [2]. To date, a total of 874 healthcare workers (HCW) have been infected and at least 509 have died [1]. Importantly, in previous outbreaks, e.g. in the Democratic Republic of the Congo in 1995 and 2003, as well as in Uganda in 2000–2001, up to 20% casualties were HCW [3, 4].

While in West Africa health systems are relatively fragile and there is often a lack of training and shortage of critical supplies, e.g. personal protective equipment (PPE), in Western civilization, the risk of transmission is considered very low if HCW are properly informed and trained and are aware of the potential risk [5].

However, the emergence of four EVD cases in October 2014 in the US and the first acquired cases to be transmitted to HCW in a hospital of the US and a Spanish hospital disturbed the illusion of safety [6, 7].

Likewise the risk of laboratory personnel, who handle samples from Ebola patients, is not negligible. Whereas virological and microbiological routine laboratories

typically handle clinical specimens and bacterial agents in biosafety level 2 (BSL-2) laboratories, highly contagious infective agents such as Ebolavirus must be analyzed in BSL-4 laboratories which represent the maximum containment level. Such BSL-4 laboratories typically operate independently from other hospital areas and offer complete sealing of the facility and highest possible protection of HCW from pathogen exposition [8]. In order to provide the highest degree of security possible, it has to be ensured that samples from (suspected) EVD patients are adequate identified so that the virological staff is not under risk.

The outbreak of the severe acute respiratory syndrome (SARS) in 2003 brought heavy stress to first-line HCW, particularly those in the emergency department and the infectious disease department [9, 10]. Of the 8096 confirmed cases of SARS 1706 occurred in HCW – including many HCW who died even in countries with a sophisticated healthcare system as in Canada [9, 11]. The outbreak of SARS showed that a large number of HCW experienced the outbreak as a psychological trauma and suffered from a high degree of distress [9, 10]. For this reason, besides sufficient training of HCW, effective risk communication is a priority early in an outbreak [11].

As at July 3, 2015 three HCW who have been infected in West Africa have been transferred to German hospitals in Hamburg, Frankfurt and Leipzig and have been treated under highly controlled circumstances [12–14]. It is still possible that patients with (suspected) EVD or other viral hemorrhagic fevers (VHFs) will be admitted to one of Germany’s high level isolation units (e.g. Frankfurt) in the future.

This study attempted to assess the personal information as well as training level of HCW working in departments that are likely to treat potential EVD patients and their concern over an occupationally acquired EVD.

Methods

The Frankfurt University Hospital is one of seven high level isolation units in Germany. From August 12 to August 22, 2014, HCWs of the emergency department and of the infectious ward as well as laboratory personnel of the Institute of Medical Virology were asked to complete an anonymous questionnaire (see Appendix 1). The questionnaire comprised twelve questions divided into three areas of inquiry:

1. Demographic data: age, sex, professional group, medical department
2. Information sources and informational needs with regard to EVD control measures
3. Risk perception

The questionnaire was developed based upon studies which were done among HCW after the SARS outbreak in 2003 and pretested among five HCW [9–11].

Ethical considerations

The study was approved by the Head of the Ethics Committee of the Goethe-University Faculty of Medicine on August 11, 2014, no formal vote was required.

Participants were informed that all the information gathered would be anonymous and kept confidential. Participation was voluntary, completion of the questionnaire implied consent for study participation.

Statistical analyses

A p-value of <0.05 was assumed as statistically significant. Calculations of significance were performed using the program BiAS for Windows 9.04 (Epsilon Verlag, Hochheim-Darmstadt, Germany).

Results

Of the 99 HCW eligible for the study (emergency room $n=40$, infectious diseases department $n=31$, Institute of Medical Virology $n=28$), 70 completed the anonymous questionnaire (response rate 70.7%). Demographic characteristics of the study population are shown in Table 1. Table 2 describes respondents' subjective perception of their training and information level. Seventy percent of our total population stated that they have all the information needed to care for Ebola patients. The information level was perceived highest among emergency department staff (89.7%) and the lowest among laboratory workers (18.2%). Notably, only 29.4% of the HCW of the Institute

of Medical Virology felt that they have all the information needed to deal with EVD and felt sufficiently trained. On the other hand, 58.6% of our total study population felt sufficiently trained, with the highest rate among infectious disease department staff (70.8%). HCW under 30 felt significantly more often not sufficiently trained compared to HCW over 30 years old ($p=0.011$). In general, men felt significantly more often sufficiently trained than women ($p=0.012$) and stated significantly more often than women that they have all the information needed to care for Ebola patients ($p=0.022$).

In addition Table 2 describes the subjective risk perception and the level of concern. HCW reported a low level of concern regarding EVD, 70% perceived a low or an almost zero risk of contracting an occupational EVD. By far the lowest level of concern was perceived among the HCW of the Institute of Medical Virology.

The HCW rated the Internet (64.3%) and the daily press (54.3%) as the most important sources of information. Medical literature (45.7%) and official institutions (e.g. CDC, Robert Koch Institute) (40.4%) were rated less often. However, physicians rated official institutions (87.5%) and medical literature (66.7%) as more important sources than nurses and laboratory workers did (Table 3). Men stated significantly more often as woman medical literature and official institutions as information sources ($p=0.034$).

Discussion

Although the occupational and psychological effects of HCW exposure to blood borne viruses like HIV and hepatitis B/C have been exhaustively studied, emerging infections like Ebola present a new challenge for HCW. While Ebola is highly infectious in certain circumstances, Ebola is an infectious disease that can be contained under controlled working conditions, as Ebola virus is not a respiratory disease and not spread through the airborne route [1].

It is to be assumed that patients with EVD can be cared for safely in properly prepared hospitals [12]. This includes the handling of clinical samples in laboratory settings. Therefore samples not only from EVD patients but also from patients with other (suspected) hemorrhagic fevers (VHFs) (Table 4) might be of special risk for HCW and laboratory workers [15]. Depending on the classified biosafety level of the viruses, such samples need to be handled under highest safety precautions [8]. While the clinical chemistry parameters from Ebola patients are often determined by point of care tests in the high-level isolation

Table 1: Demographic characteristics of the study population ($n=70$).

	%	n
Gender		
Female	52.9	37
Male	47.1	33
Age, years		
Up to 30	24.3	17
31–40	45.7	32
41–50	22.9	16
51–60	5.7	4
Over 60	1.4	1
Occupational group		
Physicians	34.3	24
Nurses	50.0	35
Laboratory workers	15.7	11
Department		
Emergency Room	41.4	29
Infectious Ward	34.3	24
Medical Virology	24.3	17

Table 2: Respondents subjective perception of training and information level as well as risk perception and level of concern (n=70).

Do you feel sufficiently trained?	Overall (n=70)	Departments			Occupational group		
		Emergency room (n=29)	Infectious disease department (n=24)	Virology (n=17)	Physicians (n=24)	Nurses (n=35)	Laboratory workers (n=11)
Yes	58.6%	65.5%	70.8%	29.4%	66.7%	65.7%	18.2%
No	14.3%	10.3%	8.3%	29.4%	8.3%	11.4%	36.4%
Partly	25.7%	24.1%	20.8%	35.3%	25.0%	22.9%	36.4%
Don't know	1.4%	–	–	5.9%	–	–	9.1%
Sufficient information							
Yes	70.0%	89.7%	75.0%	29.4%	79.2%	80.0%	18.2%
No	30.0%	10.3%	25.0%	70.6%	20.8%	20.0%	81.2%
Risk of an occupational Ebola infection							
Very high	2.9%	3.4%	–	5.9%	–	2.9%	9.1%
High	7.1%	13.8%	4.2%	–	–	14.3%	–
Moderate	20.0%	44.8%	4.2%	–	16.7%	28.6%	–
Low	42.9%	27.6%	66.7%	35.3%	33.3%	45.7%	54.5%
Almost zero	27.1%	10.3%	25.0%	58.8%	50.0%	8.6%	36.4%
Level of concern							
Pretty high	4.3%	10.3%	–	–	–	8.6%	–
Moderate	34.3%	58.6%	25.0%	5.9%	25.0%	48.6%	9.1%
Not at all	61.4%	31.0%	75.0%	94.1%	75.0%	42.9%	90.9%

Table 3: Source of information (n=70).

Information sources	Overall (n=70)	Departments			Occupational group		
		Emergency room (n=29)	Infectious disease department (n=24)	Virology (n=17)	Physicians (n=24)	Nurses (n=35)	Laboratory workers (n=11)
Daily press	54.3%	58.6%	37.5%	70.6%	50.0%	54.3%	63.6%
Internet	64.3%	58.6%	62.5%	76.5%	50.0%	68.6%	81.8%
Medical literature	45.7%	31.0%	58.3%	56.3%	66.7%	31.4%	45.5%
Official institutions	40.4%	31.0%	54.2%	41.2%	87.5%	20.0%	9.1%

units, the Ebola specific diagnostic need to be performed under BSL-4 conditions. The current diagnostic tools for Ebola and other hemorrhagic fevers are listed in Table 4.

Under “Western working conditions” HCW adhering to strict infection control principles by wearing PPE thoroughly, might only be infected due to a needlestick injury (NSI). This knowledge seems to be reflected in the risk perception of our study population and their low level of concern (Table 2). Previous studies have shown that high levels of PPE knowledge were significantly correlated to HCWs’ confidence in PPE [16]. However, it should be noted that at least five NSI with Ebola virus are documented in the literature and one of these cases was fatal [17–20]. The risk for HCW even under sophisticated working conditions is not zero. Until July 2015, three HCW have contracted EVD while caring for EVD patients in the US and Spain [7, 21]. Jeffrey Koplan, the former CDC

director stated 2001 during the anthrax scare “*We will learn things in the coming weeks that we will then wish we had known when we started*” [22]. In this respect it is surprising that the HCW of the Institute of Medical Virology perceived the lowest level of concern, despite <30% of them felt sufficiently trained and informed. A possible reason for this may be that the HCW of the virological laboratories have an elevated demand on risk specific information about laboratory samples of confirmed or highly suspected EVD cases due to their work. On the other hand such samples won’t be tested at the Frankfurt university hospital, they will be sent to one of the two German specialized BSL-4 laboratories in Hamburg or Marburg. A laboratory sample from a patient who not completely fulfils the case definition of EVD will be inactivated at BSL-3 and is than no longer infectious. However, in a preliminary report of the WHO on HCW Ebola infections

Table 4: Characteristics of selected important hemorrhagic fever virus infections.

Viruses/virus family	Disease	Incubation period (d)	Natural host	Human-to-human transmission	Source	Laboratory BSL level	Commercial available diagnostic assay: Sero/NAT ^a
Dengue virus/Flaviviridae	Dengue fever; dengue hemorrhagic fever	(3) 4–7 (14)	Mosquito	No	Africa, Tropical America, Eurasian	3	Yes/Yes
Yellow fever virus/Flaviviridae	Yellow fever	3–6	Mosquito	No	Africa, Tropical America	3	Yes/ ^b
Lassa virus/Arenaviridae	Lassa fever	(3) 7–10 (21)	Rodent	Yes	West Africa	4	^b / ^b
Junin virus/Arenaviridae	Argentine hemorrhagic fever	6–14	Rodent	Unknown	Argentina	4	^b / ^b
Ebola virus/Filoviridae	Ebola hemorrhagic fever	2–25	Flying fox	Yes	Africa	4	Yes/Yes
Marburg virus/Filoviridae	Marburg hemorrhagic fever	(3) 5–7 (10)	Flying fox	Yes	Africa	4	^b /Yes
Hantaan virus/Bunyaviridae	Hemorrhagic fever with renal syndrome	(5) 12–21 (42)	Rodent	No	Eurasian	3	Yes/Yes
Krim-Kongo virus/Bunyaviridae	Krim-Kongo hemorrhagic fever	2–13	Tick	Yes	Africa, Eurasian	4	Yes/Yes
Rift-Valley virus/Bunyaviridae	Rift Valley fever	2–6	Mosquito	No	Africa, Arabian Peninsula	3	Yes/Yes
Chikungunya virus/Togaviridae	Chikungunya fever (seldom hemorrhagic)	(2) 3–7 (12)	Mosquito	No	Africa, Eurasian	3 ^b	Yes/Yes

^aSero, serological assays (including antigen assays); NAT, Nucleic acid amplification test. For further information: e.g. <http://www.enivd.de/index.htm>. ^bOnly in specialized laboratories available.

in Guinea, Liberia and Sierra Leone, laboratory worker accounted for 7% of Ebola infections among HCW, so the risk of laboratory worker is not negligible [23]. Based on the results of our questionnaire, the HCW of the Institute of Medical Virology have received intensive and detailed training sessions in the meantime.

Communicating with HCW within the healthcare system is often a highly complex task. However, a clear communication and knowledge of and trust in infection control measures are of utmost importance in containing an infectious disease outbreak. For this reason, there is a need to identify the sources of information of HCW. Although there is plenty professional information available, internet and newspapers are widespread sources of information among our study population. This is maybe due to the easy access to these sources. In our survey, we found differences regarding the common sources of information among occupational groups and men and women. In general, men relied more often on medical literature and official institutions as an information source. They felt more often sufficiently trained and stated more often that they have all the information needed to care for Ebola patients compared to women. Physicians relied primarily on official institutions such as Robert Koch Institute (RKI) or CDC and medical literature, whereas the internet was the main information source of nurses and laboratory workers (Table 3).

Our study has several limitations. First, the results from a single academic institution in one country may not be applicable to other institutions. Second, it was a small-sized study population, albeit the response rate was high. Third, any data on practical skills as to safety measures mastered or not mastered by HCW when handling (stand-in) EVD patients was available.

Conclusions

The results of our survey among HCW and laboratory staff showed that even in a University Hospital the information about how to handle Ebola infected patients is insufficient in certain areas. Furthermore, a good deal of laboratory workers of the Institute of Medical Virology felt not sufficiently trained. The internet was the most important source of information.

These are important findings of practical relevance for laboratory staff which show that there is a potential risk for occupational infection due to insufficient information and training with regard to the management of patients (and their clinical samples) which may suffer from a severe and highly contagious and “rare” infectious disease.

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Appendix 1: Questionnaire

The questionnaire comprised the following questions with predetermined answers:

1. **Job description**
 - Physician
 - Nurse
 - Laboratory worker
 - Others
2. **Department**
 - Emergency room
 - Infectious disease department
 - Institute of Medical Virology
3. **Gender**
 - Male
 - Female
4. **Age**
 - up to 30 years
 - 31–40 years
 - 41–50 years
 - 51–60 years
 - Over 60 years
5. **Were there already cases of hemorrhagic fever in your department?**
 - Yes
 - No
 - Don't know
6. **Do you feel sufficiently trained to care for patients with (suspected) Ebola Virus Disease (EVD)?**
 - Yes
 - No
 - Partly
 - Don't know
7. **If there would be a patient or a laboratory sample with suspected Ebola Virus Disease (EVD) which kind of personal protective equipment would you use?**
 - Double gloves
 - Eye protection
 - Surgical mask
 - FFP2/3 mask
 - Disposable, impermeable gown
 - Others
8. **Do you know where to get sufficient personal protective equipment (PPE) at your workplace?**
 - Yes
 - No
9. **Do you have all the information needed to care for Ebola patients?**
 - Yes
 - No
10. **What kind of information sources do you use to get information regarding Ebola virus disease (EVD)?**
 - Daily press
 - Internet
 - Medical literature
 - Official institutions (e.g. CDC, Robert Koch-Institute)
11. **How high to you estimate the risk of transmission of Ebola Virus Disease (EVD) at your workplace?**
 - Very high
 - High
 - Moderate
 - Low
 - Almost zero
12. **Level of concern because of an occupational transmitted Ebola infection?**
 - Pretty high
 - Moderate
 - Not at all

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