Original Research

Assessment of knowledge, attitudes and perceptions regarding Ebola disease in healthcare workers from a tertiary care hospital in Romania

D. Piţigoi [a,b], O. Săndulescu [a,b,*], T. Ionescu [c], B. Niţescu [a], M. Niţescu [a,b], A. Streinu-Cercel [a,b], A. Streinu-Cercel [a,b]

[a] Carol Davila University of Medicine and Pharmacy, No. 37 Dionisie Lupu Street, Bucharest, 030167, Romania
[b] National Institute for Infectious Diseases 'Prof. Dr. Matei Balş', No. 1 Dr. Calistrat Grozovici Street, Bucharest, 021105, Romania
[c] National Institute of Endocrinology C. I. Parhon, No. 34-36 Aviatorilor Street, Bucharest, 011863, Romania

ABSTRACT

Objectives: The National Institute for Infectious Diseases 'Prof. Dr. Matei Balş' was the designated centre for managing Ebola alerts in Romania during the 2014 African outbreak. We surveyed Ebola knowledge, attitudes and perceptions (KAP) among the institute's healthcare workers.
Study design: This was a cross-sectional survey.
Methods: The study consisted of a self-administered paper-based anonymous questionnaire that included 24 closed-item questions and two scales of personal concern.
Results: Respondents were generally well informed; compared to nurses, doctors recorded a 1.9-fold higher rate of correct responses regarding Ebola transmission ($P < 0.001$), but both nurses and doctors correctly identified Ebola's aetiological agent. Nurses perceived higher personal ($P = 0.008$) and family ($P < 0.001$) risk than doctors. Respondents reporting high perceived risks were more likely to be less informed about Ebola ($P = 0.019$) and its prevention options ($P = 0.033$). Males were 6.7-fold more likely to volunteer than females ($P = 0.001$) and so were graduates of higher rather than lower education (1.5-fold more likely, $P = 0.017$) and doctors than nurses (1.7-fold more likely, $P = 0.018$). The institute ranked first among sources of information on Ebola; respondents who had received Ebola training in the institute 2 years previously were 1.2−1.3 times more likely to correctly identify transmission routes.
Conclusions: We have characterised KAP on Ebola disease among Romanian healthcare workers from a tertiary care hospital in Bucharest. Nurses, specialist physicians and laboratory personnel may need more frequent retraining than residents and senior physicians.
© 2018 The Royal Society for Public Health. Published by Elsevier Ltd. All rights reserved.

* Corresponding author. Carol Davila University of Medicine and Pharmacy, Bucharest, National Institute for Infectious Diseases 'Prof. Dr. Matei Balş', No. 1 Dr. Calistrat Grozovici street, Bucharest 021105, Romania. Tel.: +40213186090; fax: +40213186090.
E-mail addresses: danielapitigoi@yahoo.co.uk (D. Piţigoi), oana.sandulescu@umfcd.ro (O. Săndulescu), teo.ionescu@yahoo.com (T. Ionescu), drnitescubogdan@gmail.com (B. Niţescu), mnitescudsp@gmail.com (M. Niţescu), anca.streinucercel@gmail.com (A. Streinu-Cercel), astreinucercel@yahoo.com (A. Streinu-Cercel).

Introduction

The Ebola outbreak that started in 2014 in West Africa is the largest to date,[1] having lasted for 2 years, from March 2014 to March 2016, and carrying a major burden on the healthcare system,[2] with a suspected case count of 28,652, a confirmed case count of 15,261, and a death toll of 11,325.[3,4]

European countries were mostly spared by this outbreak, but the increase in international travel seen during the past years has led to more efficient travel of pathogens as well.[5] Therefore, a series of four alerts (of which three were suspected cases) have also been managed in Romania; these were patients who had travelled to Nigeria (two cases) and Sierra Leone (one case), whereas the fourth alert lacked a relevant epidemiological context. In the three suspected cases, Ebola infection was ruled out, and the patients were rapidly diagnosed with malaria.

The National Institute for Infectious Diseases 'Prof. Dr. Matei Balş' in Bucharest was the designated reference centre for the management of public health alerts in Romania (avian influenza, severe acute respiratory syndrome (SARS), pandemic influenza) and Ebola alerts during the 2014 outbreak. Suspected cases were managed in negative pressure isolation units, and the institute implemented designated Ebola protocols and circuits for patients, medical personnel, healthcare materials, biologic samples and medical waste. In the institute, healthcare workers (HCWs), including but not limited to physicians, nurses and nurses' aides, receive yearly training on standard precautions, while during 2014, they were invited to participate in training on five specific Ebola-related topics, namely, correct use (donning and doffing) of personal protective equipment, protective measures, circuits for suspected Ebola cases, management of biological risk and case management. Based on the experience acquired during the outbreak, the institute has created the Romanian Centre for Applied Bio-Molecular Research in Infectious Diseases, a state-of-the-art research and treatment facility.

We performed a survey to assess the knowledge and perceptions of the institute's HCWs regarding Ebola disease, 2 years after the beginning of the largest Ebola outbreak to date.

Methods

This was a cross-sectional survey consisting of a self-administered paper-based anonymous questionnaire in Romanian that included 24 closed-item questions and two scales of personal concern and was designed to assess multiple aspects related to Ebola disease, namely: (a) respondent characteristics—eight questions; (b) knowledge regarding Ebola (aetiology, transmission, signs and symptoms, severity, treatment and vaccination options)—six closed questions; (c) local epidemiology of Ebola disease—one closed question; (d) perception of personal/family/national risk and willingness to work with patients with Ebola infection—four closed questions and two scales from 1 (lowest) to 10 (highest) evaluating the degree of personal concern; and (e) preparedness activities, specific training and sources of information on Ebola and the recent epidemic—five closed questions. The English

translation of the full questionnaire is available as Supplementary material.

The surveyed population consisted of HCWs from the National Institute for Infectious Diseases 'Prof. Dr. Matei Balş'. The questionnaire was distributed to all medical staff through division chiefs, and no category of HCWs was specifically excluded from the survey.

The study protocol, informed consent form and questionnaire were approved by the Bioethics Committee of the National Institute for Infectious Diseases 'Prof. Dr. Matei Balş' (approval no. 3426 from 01 June 2016) before study initiation. The questionnaire was administered once during 1–30 June 2016 to all HCWs who gave their informed consent to participate.

The statistical analysis was performed with IBM SPSS Statistics for Windows, version 22 (IBM Corp., Armonk, NY, USA). For continuous non-normally distributed variables, we report medians and interquartile ranges (IQRs), along with the results of the Mann–Whitney U test and effect size and Spearman's rank-order correlation. For categorical variables, we report the results of the χ^2 test with its φ or Cramer's V effect and relative risk (RR) along with 95% confidence intervals (95% CIs) for risk estimates. For comparing categorical characteristics of study respondents and non-respondents, we applied the two-sided z test for two population proportions. Multiple regression analysis was performed to predict continuous outcome variables based on respondent characteristics.

Results

Respondent characteristics

The questionnaire had a moderate response rate, with 180 respondents out of a total number of 452 employees (39.8%). After excluding incomplete questionnaires, a number of 157 questionnaires were validated and included in the final analysis. The median (IQR) age of respondents was 41 (33.5–47) years, with an overall predominance of females (91.7%), reflecting to some degree of the overrepresentation of females in the healthcare sector in Romania in general and in the institute in particular (91.2%). The majority of the respondents were nurses (63.7%), and the rest were doctors (36.3%): senior specialists (17.8%), residents (12.1%) and specialists (6.4%). Table 1 includes a description of the institute's structure of medical personnel and statistical comparisons between respondents and non-respondents, highlighting that nurses were slightly underrepresented, whereas resident physicians were slightly overrepresented in our survey, but the gender distribution was similar in both groups. The respondents' distribution was balanced between adult wards (37.8%) and children's wards (35.3%), but other divisions were also represented, including intensive care (12.2%), laboratory (5.1%), immune deficiency (4.5%) and others (5.1%), which included ambulatory care (0.6%), gastroenterology and infection control (1.9% each).

Most of the respondents were married (66.9%) and had children (68.8%), whereas 22.3% were single, 8.9% divorced/separated and 9.6% were widowers. In terms of the last form

Characteristics	Respondents	Non-respondents	Total	Z-score	P value
	157	295	452		
Female gender	144/157 (91.7%)	268/295 (90.8%)	412/452 (91.2%)	0.3	0.757
Nurses	100/157 (63.7%)	231/295 (78.3%)	331/452 (73.2%)	−3.3	<0.001
Resident physicians	19/157 (12.1%)	4/295 (1.4%)	23/452 (5.1%)	5.0	<0.001
Specialist physicians	10/157 (6.4%)	21/295 (7.1%)	31/452 (6.9%)	−0.3	0.764
Senior physicians	28/157 (17.8)	39/295 (13.2%)	67/452 (14.8%)	1.3	0.190

Table 1 − Description of the institute's structure of medical personnel and statistical comparison between respondents and non-respondents (a survey administered to healthcare workers from a national reference hospital for infectious diseases in Bucharest, Romania, in June 2016, n = 157).

We report the results of the two-sided z test for two population proportions, for the comparison of respondents and non-respondents based on gender and type of medical activity.

of education completed, most of them (54.8%) had graduated from university, one-third (37.6%) from postsecondary schools of nursing and 1.3% had only graduated from high-school, whereas 6.4% had also completed a PhD after college graduation.

The respondents had been working in the healthcare system for a median (IQR) duration of 17 (8.3−21) years, and specifically in the Matei Balş Institute for 14 (6−20) years. Notably, 13.4% of them had less than 2 years' experience in the institute at the time of completing this questionnaire, suggesting that they had not had access to the specific on-site training performed during the Ebola outbreak in 2014.

Knowledge regarding Ebola

Virtually all respondents (99.4%) had heard of Ebola, and 96.8% correctly identified the aetiological agent as a virus. Its potential for interhuman transmission was recognised by 99.4%, while 26.1% correctly identified both the viral aetiology and the transmissibility. More specialist physicians (80%) and nurses (79.8%) failed to identify Ebola correctly, compared with resident physicians (68.4%) and senior specialists (53.6%), P = 0.041, χ(3) = 8.2, with a medium effect (Cramer's V = 0.23) Fig. 1.

Most of the respondents reported they had first heard of Ebola before the 2014 outbreak (65.8%), almost one-third of them during the outbreak (29.5%) and a small minority after

the outbreak (4.7%, of which 1.3% were resident physicians and 3.4% nurses, P = 0.243, χ(2) = 7.9, medium effect, Cramer's V = 0.16). Surprisingly, among the latter, only 1.3% had less than 2 years' experience in health care, and the other 3.4% reported an experience in health care and in the institute ranging from 6 to 24 years. We identified no statistically significant association between the time when the respondent had first heard of Ebola and gender, marital status, education, occupation or duration of experience in health care.

The potential transmission routes identified by the respondents were direct contact with infected bodily fluids (100%), contact with wild animals in Africa (72.6%) and direct contact with infected but asymptomatic patients (64.7%). None of the respondents considered Ebola to be foodborne, but 54.8% mistook it for an airborne disease and 7% for a waterborne disease. Only 0.9% considered that wild animals in Romania can transmit the disease, 19.1% incriminated African mosquitoes and 11.5% stated that transmission routes are not completely understood. Interestingly, specialist physicians were significantly more likely to correctly identify all transmission routes (70%) than residents (36.8%), senior specialists (32.1%) or nurses (13.3%), P < 0.001, χ(3) = 20.9, large effect (Cramer's V = 0.37). The difference between nurses and physicians was also statistically significant, 36.1% vs 63.9%, P < 0.001, χ(1) = 14.8, medium effect (φ = 0.3), as doctors registered a 1.9-fold higher likelihood (95% CI: 1.2−3.1) of correctly identifying all transmission routes. The responses
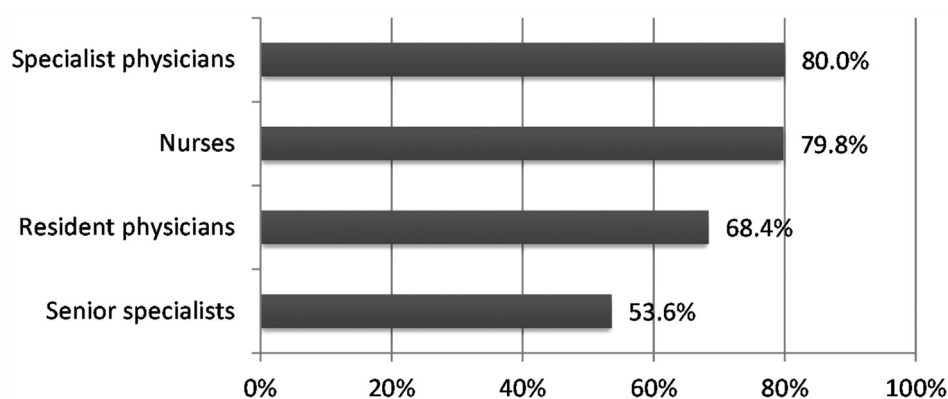

Fig. 1 − Percentage of respondents in each healthcare personnel category requiring more frequent retraining to ensure correct and current knowledge on Ebola virus disease (a survey administered in healthcare workers from a national reference hospital for infectious diseases in Bucharest, Romania, in June 2016, n = 157).

were not influenced by gender, marital status, education or duration of experience in health care.

The ranking of signs and symptoms based on respondent choices is presented in Fig. 2, the most frequent responses being fever (98.7%), myalgia (82.2%) and haemorrhaging (79.6%).

Interestingly, doctors were 1.3 times (95% CI: 1.1−1.7) more likely to misidentify haemorrhaging as frequent (89.5%) than nurses (74.7%), $P = 0.036$, $\chi(1) = 4.9$, small effect ($\varphi = 0.18$), but other factors such as gender, marital status, education or duration of experience in health care did not influence the response to this question.

Most respondents (85.8%) correctly identified Ebola as a severe and potentially fatal disease, none considered it to be mild and 14.2% labelled it as always fatal, and the results were not associated with factors such as gender, marital status, education, occupation or duration of experience in health care.

In terms of treatment and vaccination options, 72.1% of respondents correctly identified that treatment is mainly symptomatic and pathogenic and that no licenced aetiological treatment or vaccine was available internationally or locally at the time of the survey (June 2016), whereas only 12% considered that aetiological treatment is available; 9.5%, an internationally licenced vaccine and 23%, a vaccine licenced for local use in Africa. Those who correctly identified that at the time there were no licenced treatment and vaccination options were more frequently university graduates (81.4%) compared with postsecondary school (62.5%) or high-school graduates (50%), $P = 0.027$, $\chi(3) = 9.2$, medium to large effect (Cramer's V = 0.24), and were working in clinical wards (82.8% adults, 81.5% children and 100% immunodeficiency), compared with the laboratory (25%) or other wards (37.5%), $P < 0.001$, $\chi(5) = 35.2$, large effect (Cramer's V = 0.48). The response to this question was not influenced by factors such as gender, marital status, occupation or duration of experience in health care.

Local epidemiology of Ebola disease

Most of the respondents (90.4%) were aware of the fact that no confirmed cases had been recorded in Romania during the surveyed outbreak, whereas only 4.5% responded yes to this question, and 5.1% said they did not know. The response to this question was not significantly associated with any of the personal or professional characteristics of the respondents.

Risk perception and willingness to work with patients with Ebola disease

Personal risk during the Ebola outbreak was perceived as a median of 5.5 (range 3−8) on a scale of 1−10, and the respondents perceived the risk for their families as being higher, with a median of 6.5 (range 2−10) and there was a strong positive correlation between perceived personal and family risk ($P < 0.001$, $r_s = 0.75$).

Nurses were significantly more worried for themselves ($P = 0.008$, $U = 2083$, large effect size $r = 0.7$) and for their families ($P < 0.001$, $U = 1629.5$, large effect size $r = 1.2$) than doctors, with median scores of 6.5 vs 5 for personal risk and 9 vs 5 for family risk (Fig. 3).

A higher perceived personal risk was also reported by those who failed to correctly identify what Ebola is ($P = 0.019$, $U = 1783$, small-to-medium effect size $r = 0.2$), and a higher perceived family risk was reported by respondents who were unaware of how Ebola is treated and prevented ($P = 0.033$, $U = 1870.5$, $r = 0.2$); both types of risk were perceived as higher by clinical personnel than laboratory personnel (personal risk: $P = 0.025$, $U = 685$, $r = 0.2$; family risk: $P = 0.021$, $U = 684$, $r = 0.2$).

In multiple regression analysis performed to predict perceived risk from respondent age, work experience in the institute, type of medical activity performed, knowledge on Ebola and prior Ebola-specific training in the institute, only the following variables retained statistical significance in
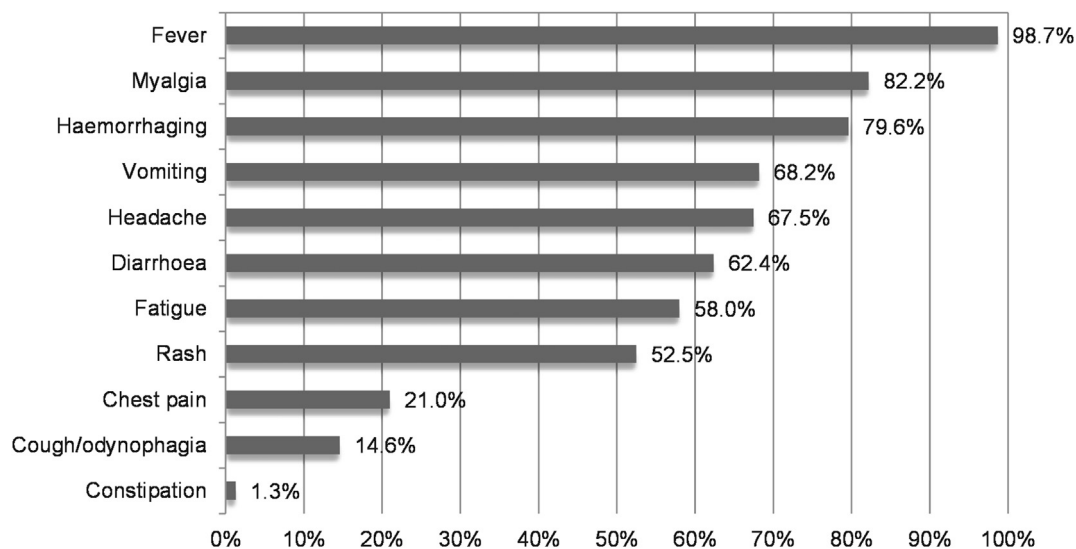

Fig. 2 − Respondents' ranking of the most frequent signs and symptoms considered to be attributed to Ebola disease (a survey administered in healthcare workers from a national reference hospital for infectious diseases in Bucharest, Romania, in June 2016, n = 157).

Fig. 3 − Self-reported retrospective perception of risk during the 2014 Ebola outbreak in medical personnel. A. Personal risk. B. Family risk (a survey administered in healthcare workers from a national reference hospital for infect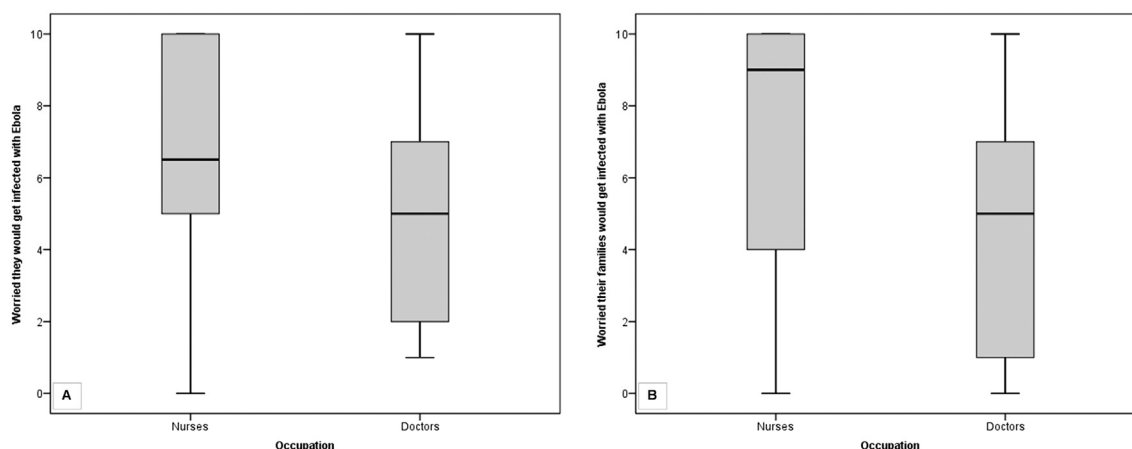ious diseases in Bucharest, Romania, in June 2016, n = 157). Risk perception was self-reported on a scale of 1 (lowest) to 10 (highest). Nurses were significantly more worried for themselves (6.5 vs. 5, P = 0.008, U = 2083, large effect size r = 0.7) and for their families (9 vs 5, P < 0.001, U = 1629.5, large effect size r = 1.2).

predicting perceived personal risk [$F_{(6, 124)}$ = 3.208, P = 0.005, R^2 = 0.116] or perceived family risk [$F_{(6, 147)}$ = 4.955, P < 0.001, R^2 = 0.168]: nurses vs doctors (P = 0.007 for personal risk and P < 0.001 for family risk) and clinical vs laboratory personnel (P = 0.007 for personal risk and P = 0.013 for family risk).

In terms of national risk in the scenario of a future Ebola outbreak, there was a tie, with almost as many respondents (49% vs 43.9%) considering that the risk of an Ebola epidemic in Romania is low (defined as less than 25%) or moderate (25%−50%). Clinical personnel tended to overestimate the risk more than laboratory personnel (47.5% of clinical personnel vs 13.3% of laboratory personnel considered the national risk to be between 25% and 50%), P = 0.008, $\chi_{(2)}$ = 9.7, medium effect Cramer's V = 0.25. Nurses also considered the risk to be higher than doctors (P = 0.023, $\chi_{(2)}$ = 7.6, medium effect Cramer's V = 0.22).

Only 6.5% of the respondents had ever come into contact with a suspected Ebola case in Romania, and 5.8% had been directly involved in managing these cases (accounting for 8 nurses and 1 senior specialist, all working in the institute's intensive care department, which had been the designated facility for managing Ebola alerts in Romania).

Roughly half of the respondents (56.1%) would be reluctant to work with Ebola patients, whereas 16.1% would volunteer, and another 9% would volunteer if motivated by a salary increase. A large proportion of respondents (18.7%) were unsure if they would volunteer if a future outbreak involves Romania. Males were more likely to volunteer (75%) than females (26.3%), P = 0.001, $\chi_{(1)}$ = 12, medium effect, φ = −0.31, RR = 6.7 (95%CI: 1.9, 23.4), and the same was true for those with higher education (37% college graduates and 62.5% PhD graduates compared with 16.3% postsecondary school and 0% high-school graduates), P = 0.017, $\chi_{(3)}$ = 10.2, fairly large effect Cramer's V = 0.28. Graduates of higher education (university or PhD) were overall 1.5 times (95% CI: 1.2−1.9) more likely to volunteer than those with lower education (high-school or postsecondary nursing school), P = 0.004, medium effect

φ = 0.25. Doctors were also 1.7 times more likely to volunteer than nurses (95% CI: 1.1−2.7), 43.8% vs 23.1%, P = 0.018, $\chi_{(1)}$ = 5.9, medium effect φ = 0.22. Age, marital status and having children did not significantly influence responses to this question.

Preparedness activities, training and sources of information

Almost two-thirds of the respondents (63.9%) considered that sufficient personal protective equipment and methods are available to prevent Ebola transmission, whereas 12.9% were uncertain. Those who responded yes to this question were also 1.4 times (95% CI: 1.1, 1.7) more likely to volunteer (86.1% compared with 63.4%), P = 0.015, $\chi_{(1)}$ = 6.0, medium effect φ = 0.24.

Almost all respondents had received or searched for information on Ebola (99.4%); sources are ranked by frequency in Fig. 4.

Most respondents had been trained in the institute in 2014 regarding Ebola-specific procedures for donning and doffing personal protective equipment (84.7%), protective measures (78.3%), circuits for suspected Ebola cases (60.5%), management of biological risk (56.1%) and case management (42%). Those who had received training on case management were also 1.3 times (95% CI: 1.1−1.6) more likely to correctly identify transmission routes in our survey (63.9% vs 35.8%, P = 0.003, $\chi_{(1)}$ = 8.9, medium effect φ = 0.24) and so were those who had received training on circuits for suspected Ebola cases (1.2 times more likely, 95% CI: 1.1−1.4), P = 0.029, $\chi_{(1)}$ = 4.2, small effect φ = 0.17. More than half of the respondents (66.2%) stated they had received enough information on Ebola, and only 21.4% said they needed further information.

The personnel requested supplementary information on a series of topics regarding Ebola infection, as described in Fig. 5. The main topics they listed were prevention methods (72%), treatment options (67.5%), Romania's preparedness plan (65%) and the institute's preparedness plan (64.3%).
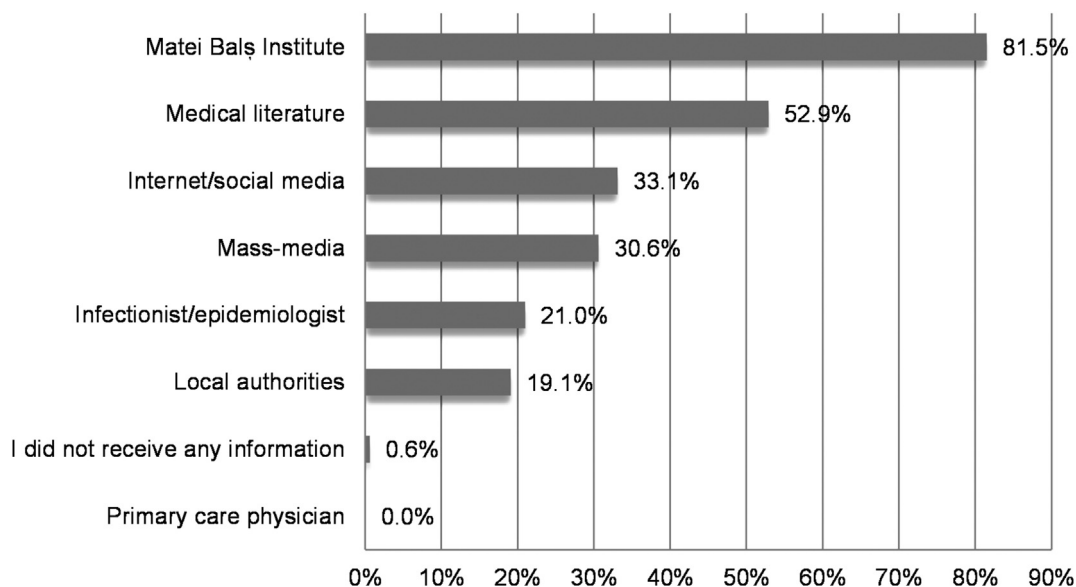
Fig. 4 – Sources of information on Ebola disease ranked by frequency of use (a survey administered in healthcare workers from a national reference hospital for infectious diseases in Bucharest, Romania, in June 2016, n = 157). Mass media was defined as comprising radio, television, newspapers and online news. Information from local authorities included official releases from the Ministry of Health, Ministry of Foreign Affairs or the National Institute for Public Health.
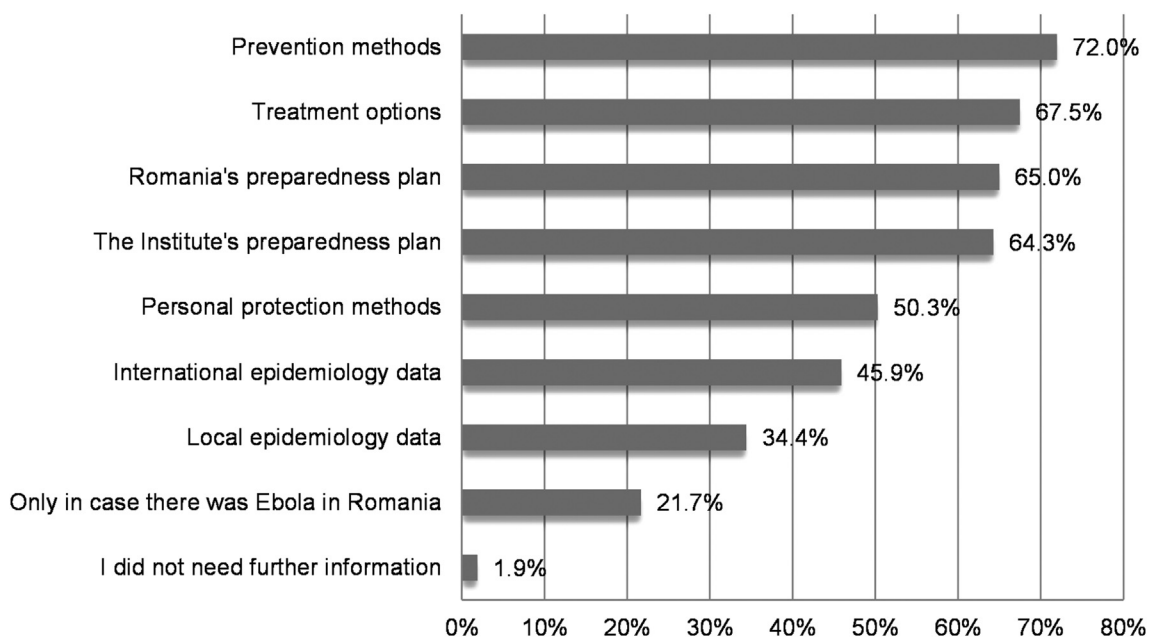

Fig. 5 – The types of information that respondents felt they needed during the 2014 Ebola outbreak (a survey administered in healthcare workers from a national reference hospital for infectious diseases in Bucharest, Romania, in June 2016, n = 157).

Interestingly, those who had correctly and completely identified the transmission routes for Ebola were also 1.2 times more likely (95% CI: 1.1–1.4) to display an interest in finding out more about Romania's preparedness plan (80.6% vs 60%, P = 0.017, χ(1) = 5.1, small effect φ = 0.18), and the same association was identified for those who correctly and completely identified Ebola's signs and symptoms and who

also wanted to find out more about the institute's preparedness plan (92.9% vs 61.5%, P = 0.015, χ(1) = 5.5, small effect φ = 0.19, RR = 1.1, 95% CI 1.1–1.2). Respondents who failed to correctly identify the aetiological agent of Ebola and its potential for interhuman transmission were more likely to request information on prevention methods (76.7% vs 58.5%, P = 0.023, χ(1) = 5.0, small effect φ = −1.8, RR = 1.8, 95% CI:

1.1–3.0), and the same was true with those failing to identify the complete transmission routes (75.7% vs 58.3%, P = 0.035, χ(1) = 4.2, small effect φ = −1.6, RR = 1.8, 95% CI: 1.1–3.2).

Discussion

Main finding of this study

We have characterised the knowledge, attitudes and perception (KAP) on Ebola disease among Romanian HCWs. Medical personnel were generally well informed about Ebola disease, but nurses, specialist physicians and laboratory personnel may need more frequent retraining than residents and senior physicians (Fig. 1).

What is already known on this topic?

The study that we are reporting here is the first survey on KAP regarding Ebola in Romania, with very few other studies having been performed in European countries, including a study in Italy in the general adult population,[6] one in Germany in the general population[7] and a third one in Spain in nursing staff involved in managing cases of suspected Ebola infection.[8] Three other studies were performed in countries directly affected by the 2014 Ebola outbreak, for example, one in the general population in Sierra Leone with the aim of quantifying the efficacy of outreach community engagement[9] and two in the medical personnel in Nigeria to assess their knowledge and preparedness,[10] as well as their reporting proficiency and risk perception.[11] These types of studies are very important as they gather relevant information regarding the potential management of Ebola suspected cases and can contribute to an indirect assessment of public health concerns.[12]

What this study adds?

In our study, respondents from the Matei Balș Institute in Romania were generally well informed on topics regarding Ebola disease. For example, 96.8% of respondents correctly identified the aetiological agent as a virus, comparable to 93.2% in a similar study conducted with HCWs in Nigeria.[10] In our study, 99.4% of respondents recognised the risk for interhuman transmission, a rate slightly higher than the one reported in the same referenced study in Nigeria (87.8%), but relatively fewer respondents (72.6%) in Romania identified the risk of animal-to-human transmission in Africa, compared to 86.2% of HCWs in Nigeria.[10] The high overall rate of correct responses identified in our HCWs may in part be due to the fact that most of the institute's personnel had also participated in a number of specific Ebola trainings during the 2014 outbreak, for example, 84.7% of them had been trained to correctly don and doff personal protective equipment and 78.3% to correctly apply protective measures.

Compared to nurses, doctors recorded a 1.9 times higher rate of correct responses regarding transmission of Ebola virus (P < 0.001), but there were no differences in the rate of correct responses regarding the aetiological agent of Ebola. Furthermore, doctors were 1.3 times more likely to misidentify haemorrhaging to be frequent than nurses (P = 0.036). Personnel

from clinical wards were better informed on Ebola treatment than laboratory personnel (P < 0.001), which is only natural, and both types of HCWs were accurately trained to recognise the correct transmission routes for Ebola.

Nurses perceived higher personal (P = 0.008) and family (P < 0.001) risk than doctors, and the same was true for clinical than laboratory personnel (P = 0.025, P = 0.021); these were the only two variables that remained statistically significant in the multiple regression analysis. This is, to a certain degree, a reflection of reality but is probably an overrepresentation of the actual risk as we also found that respondents reporting high perceived risks were more likely to be less informed about what Ebola is (P = 0.019) and about what treatment and prevention options are available (P = 0.033). A similar study conducted in Spain in 2016 reported that 48% of the nurses surveyed considered they would stand a very high risk of biological accidents if they were to care for suspected cases of Ebola infection.[8] However, their study did not quantify risk perception on a continuous scale, but rather as very low through very high, and therefore, a direct comparison with our results cannot be performed. A survey of the Italian general population found a similar association between the affective response to Ebola (degree of worry) and the lack of knowledge on Ebola[6] and so did the German general population survey.[7]

In our study, males were 6.7 times more likely to volunteer to work with patients with Ebola disease than females were (P = 0.001) and so were graduates of higher rather than lower education (1.5 times more likely, P = 0.017), doctors than nurses (1.7 times more likely, P = 0.018) and respondents who believed that sufficient personal protective equipment and methods are available to prevent Ebola transmission (1.4 times more likely, P = 0.015). In the German general population, males were also more likely to volunteer,[7] which is in line with our study, but so were younger persons, an association which was not detected in our study.

The institute ranked first in our study among the sources for acquiring information on Ebola disease, reflecting the specific trainings implemented during the 2014 Ebola outbreak, and it was followed by medical literature. Social media ranked third and mass media, fourth, and both may have played a more important role, as described in the literature,[13–16] for those HCWs who had worked in the institute for less than 2 years. The study performed by Olowookere et al. revealed radio (37.2%) and the internet (28.4%) as frequent sources of information on Ebola for HCWs in Nigeria,[10] similar to the data seen in our study, where 33.1% of respondents cited the internet and 30.6% cited mass media as sources of information. This relatively low use of mass media in HCWs for information purposes (lower than the rate of 53.1% use of television and 45.5% use of internet for retrieving information on Ebola by the general population in Germany[7]) is probably due to the fact that most of our HCWs (81.5%) had already received pertinent information at the time of our survey from their employer, the Matei Balș Institute. An encouraging finding was that those who had received various trainings on Ebola disease in the institute during the 2014 outbreak were 1.2–1.3 times more likely to correctly identify transmission routes 2 years later during our survey in 2016. Another important aspect is that respondents who did not correctly

identify Ebola or its transmission routes in our survey self-reported 1.8 times more frequently that they felt the need for more information on prevention methods, suggesting that when there is a gap in knowledge, this is self-acknowledged and can thus be remedied promptly.

Limitations of this study

The main limitation of the study is that the questionnaire was not administered before the Ebola outbreak, and therefore, the exact impact of the outbreak on personnel KAP could not be measured through this survey. However, our study does provide robust data in terms of Ebola preparedness and risk perception, and the fact that it has been applied after the end of the outbreak offers the unique advantage of providing reliable data, outside of the window of maximum emotional involvement. Therefore, the information can better be generalised and can also serve as a baseline evaluation for further panel surveys to assess the impact of interventions and trainings to be deployed in Romania in the following years.

Our finding that male HCWs were more likely to volunteer than female HCWs may be limited by the low sample of male respondents (i.e. only 13) included in the study. Therefore, this information should be interpreted with caution as it needs validation in further studies.

Some of the limitations of our survey include the moderate response rate of 39.8% and the fact that nurses were slightly underrepresented and resident physicians were slightly overrepresented among the survey respondents compared to the structure of the institute's medical personnel. Other limitations include the fact that the questionnaire was self-administered, and importantly, the fact that our study's results are not generalisable to HCWs all over Romania as the survey was conducted in a tertiary university hospital from the country's capital, a referral facility for public health emergencies, including Ebola. Therefore, the medical personnel from this institute may have had easier access to specific information and training than other HCWs outside the country's capital or from non-tertiary infectious diseases hospitals.

Conclusions

In conclusion, our study has successfully characterised the KAP of Ebola disease among HCWs from a reference centre in infectious diseases in Bucharest, Romania. This study has highlighted certain categories of personnel who need more frequent retraining (i.e. nurses, specialist physicians and laboratory personnel) than resident physicians and senior specialists, who displayed up-to-date information on Ebola disease, although a time span of 2 years or longer had elapsed since their last specific training on this topic.

Author statements

Ethical approval

The study protocol, the informed consent form and the questionnaire were approved by the Bioethics Committee of the National Institute for Infectious Diseases 'Prof. Dr. Matei Balş' (approval no. 3426 from 01 June 2016) before study initiation. All respondents gave their informed consent to participate.

Competing interests

None declared.

Contributors

Daniela Piţigoi has contributed to study design, study implementation, data collection and data interpretation and critically revised the manuscript.

Oana Săndulescu has contributed to study design and data interpretation and wrote the first manuscript draft.

Teodora Ionescu has contributed to study implementation and data collection and provided feedback on the manuscript.

Bogdan Niţescu has contributed to study implementation, data collection and data interpretation and provided feedback on the manuscript.

Maria Niţescu and Anca Streinu-Cercel have contributed to study implementation and data interpretation and provided feedback on the manuscript.

Adrian Streinu-Cercel has contributed to study design, study implementation and data interpretation and critically revised the manuscript.

All authors have approved the final article.

REFERENCES

1. Streinu-Cercel A. Ebola virus disease — a global threat. *Germs* 2014;**4**:58.
2. Elston JW, Cartwright C, Ndumbi P, Wright J. The health impact of the 2014—15 Ebola outbreak. *Publ Health* 2017;**143**:60—70.
3. Centers for Disease Control and Prevention. *2014—2016 Ebola outbreak in West Africa*. 2016 [10.02.2017]; Available from: https://www.cdc.gov/vhf/ebola/outbreaks/2014-west-africa/.
4. World Health Organization. *Ebola outbreak 2014—2015*. 2017 [15.03.2017]; Available from: http://www.who.int/csr/disease/ebola/en/.
5. Streinu-Cercel A. At the end of summer. *Germs* 2013;**3**:80.
6. Prati G, Pietrantoni L. Knowledge, risk perceptions, and xenophobic attitudes: evidence from Italy during the Ebola outbreak. *Risk Anal* 2016;**36**:2000—10.

7. Rubsamen N, Castell S, Horn J, Karch A, Ott JJ, Raupach-Rosin H, et al. Ebola risk perception in Germany, 2014. *Emerg Infect Dis* 2015;**21**:1012–8.

8. Grau Giner A, Fornieles Moreira M, Marquez Mora M, Moragas Bayes N, Rodriguez Ruiz MJ, Gisbert Cases A. Evaluation of the perception of risk in the nursing staff in care of patients with suspected biological hazard. *Rev Enferm* 2016;**39**:8–13.

9. Jiang H, Shi GQ, Tu WX, Zheng CJ, Lai XH, Li XX, et al. Rapid assessment of knowledge, attitudes, practices, and risk perception related to the prevention and control of Ebola virus disease in three communities of Sierra Leone. *Infect Dis Poverty* 2016;**5**:53.

10. Olowookere SA, Abioye-Kuteyi EA, Adepoju OK, Esan OT, Adeolu TM, Adeoye TK, et al. Knowledge, attitude, and practice of health workers in a tertiary hospital in Ile-Ife, Nigeria, towards Ebola viral disease. *J Trop Med* 2015;**2015**, 431317.

11. Ajayi NA, Ojide CK, Ajayi IA, Ukwaja KN. Evaluation of clinicians' reporting proficiency and their risk perceptions of Ebola virus disease in Ebonyi State, Nigeria. *Germs* 2017;**7**:140–8.

12. Elston JW, Moosa AJ, Moses F, Walker G, Dotta N, Waldman RJ, et al. Impact of the Ebola outbreak on health systems and population health in Sierra Leone. *J Public Health (Oxf)* 2016;**38**:673–8.

13. Hossain L, Kam D, Kong F, Wigand RT, Bossomaier T. Social media in Ebola outbreak. *Epidemiol Infect* 2016;**144**:2136–43.

14. Hobbs C, Myles P, Pritchard C. A content analysis of the UK press response to the diagnosis of Ebola in a British healthcare worker. *J Public Health (Oxf)* 2017;**39**:e219–28.

15. Fung IC, Fu KW, Chan CH, Chan BS, Cheung CN, Abraham T, et al. Social media's initial reaction to information and misinformation on Ebola, August 2014: facts and rumors. *Publ Health Rep* 2016;**131**:461–73.

16. Seltzer EK, Jean NS, Kramer-Golinkoff E, Asch DA, Merchant RM. The content of social media's shared images about Ebola: a retrospective study. *Publ Health* 2015;**129**:1273–7.

Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.puhe.2018.07.002.