IMPLEMENTATION OF ENVIRONMENTAL RECOVERY TRAINING RESPONSE TO BIOLOGICAL INCIDENTS IN A HUMAN HEALTH DEGREE

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Abstract

Agents involved in biological incidents and outbreaks of infection can spread easily, so response teams are required to quickly implement a recovery plan to decontaminate and restore the environment impacted by these incidents to minimise public risks. A group of academics at De Montfort University (DMU, UK), with support from first responders during the 2014-16 Ebola outbreak, are developing appropriate training to provide basic skills so human health science students can respond to biological incidents. Following the competences identified by the European Commission, we have created key competences for these students based on the core skills that any medical first responder to biological emergencies should have. To provide students with the key competences related to environmental planning, we have created specific training that consisted of a 2 hours practical plus theory related to emerging diseases and the international response provided to tackle the Ebola pandemic. The practical component was a research-led workshop to develop a complete protection and recovery plan to respond to an outbreak of infection by *Cyclospora cayetanensis* in an urban area. Students used the novel methodology developed by Public Health England ["UK Recovery Handbook for Biological Incidents" (Pottage et al., 2015)] [1] to select appropriate options or techniques to protect and recover the affected environment, according to the physiological characteristics of the biological agent/microorganism involved and the environment impacted. Critical thinking and discussion is also needed to select recovery options (R.O.), *e.g.* use of chlorine-based decontamination liquids as part of the R.O. "reactive liquids" will have limited efficacy as oocysts of *Cyclospora* are resistant to these. After successful testing of the training with postgraduate students, we introduced it in a level 6 module in the DMU degree programme BMedSci in Medical Science in 2016/17 (n=24). A small proportion of these BMedSci students reported that they did not enjoy (13.4%) or were not satisfied (20%) with the training provided, which could be attributed to the fact that the topic of the training (environmental sciences) was not of direct interest for these students who are studying a degree more related to medicine. However, despite the short duration of the training, students were able to tailor an appropriate response with the resources and information provided (physiological characteristics and a literature review on decontamination/inactivation techniques for *Cyclospora* was provided to overcome time constraints). Specifically, 73.3% indicated that they gained some public health prevention/preparedness knowledge against a biological incident; 80% highlighted that they learnt how to establish some public health interventions; and 60% learnt how to tailor a recovery plan. A few students (20%) had difficulties with the recovery concepts and the interpretation of the physiological characteristics, which may be attributed to limited background knowledge of microbiology and parasitology (as the BMedSci programme does not have a complete module dedicated to the study of these topics). In conclusion, the increased prevalence of biological contamination incidents necessitates development of appropriate training to include environmental decontamination strategies to protect human health. The short teaching intervention described in this paper could be used to easily address this necessity.

Keywords: Biological incidents, *Cyclospora*, undergraduate training, environmental decontamination, recovery.

1 INTRODUCTION

A critical step in the aftermath of a biological incident or accident (accidental or deliberate release of a biological hazard) is to decontaminate and recover the affected environment [2,3]. Biological incidents can affect different areas and environments, requiring cross-government efforts and special tools and agents to decontaminate [4], in conjunction with personnel appropriately trained and skilled to respond to the incident [5]. Despite medical doctors and related health care professionals and public health

officers providing the first-response to incidents involving biological threats, recent studies have reported insufficient knowledge or skills to respond to these events by many such personnel [5].

Thus, our teaching innovation group at De Montfort University (DMU, Leicester, UK) in collaboration with European academics from University of Alcalá (Madrid, Spain) and first responders during the 2014-16 Ebola outbreak in West Africa have developed preliminary training to respond to biological incidents specifically designed for students enrolled in any human health science degree. A description of the training has been comprehensively described in Peña-Fernández et al. (2017) [6], after developing basic competences for undergraduate students [7] based on the main competences identified by the European Commission for medical responders [8]. Specific training includes teaching and training (research-led workshops) that covers our basic competences, which were distributed in six domains: identification of the risk and risk analysis; toxicological effect of biological agents; planning and organisation of an intervention programme; communication and information management; safety and personal protective equipment; societal and ethical reflections. The domain "planning and organisation of an intervention programme" includes the decontamination and recovery of those areas and environments impacted by biological substances, which are critical in any response to appropriately to any biological incident to protect human health and minimise morbidity and mortality [1,9] is little considered in any existing training .

2 ENVIRONMENTAL DECONTAMINATION TRAINING

The specific training or research-led workshop created at DMU that covers the environmental decontamination, recovery and restoration of an area impacted by biological hazards has been described in Peña-Fernández et al., 2017 [6], 2018 [10]. Briefly, students are required to tailor a recovery and remediation response to a biological outbreak due to a coccidian human parasite (*Cyclospora cayetanensis*) affecting soil and different food production systems. Students use the novel methodology developed by Public Health England in the UK Recovery Handbook for Biological Incidents (UKRHBI; Pottage et al., 2015 [1]). The UKRHBI provides a series of recovery options (ROs), which are actions or techniques to protect, decontaminate and dispose generated wastes, to decontaminate, recover and remediate different environments impacted by biological hazards. ROs are selected/ rejected according to the physiological characteristics of the organism and the characteristics of the site [1]. Finally, students are provided with all the necessary information to inform their decisions including a table with detailed information on the physiological characteristics of *C. cayetanensis*, which they need to reject/select ROs that the UKRHBI suggests during the process of tailoring the response.

2.1 Preliminary results on the training

The environmental decontamination training for biological incidents has been tested with undergraduate and postgraduate students, which have reporting the following feedback by using a specific feedback-questionnaire:

- Third year Pharmacy students at University of San Pablo CEU (Spain) in 2016/17 (33 responses out of 101 students; Peña-Fernández et al., 2017 [6]): 93.9 % described that they had gained some knowledge to tailor a basic recovery plan in the aftermath of a biological incident; and 87.9% of participants indicated that the UKRHBI helps them to tailor their responses and aided their learning.
- Postgraduate students enrolled in the MSc Advanced Biomedical Science at DMU in 2017/18 (9 students enrolled) reported that [10]: all learnt how to establish basic interventions (33.3% agreed; 66.7% strongly agreed) to protect human health in the aftermath of a biological incident; were able to select recovery options and design a recovery plan (100% agreed); and provided similar feedback as pharmacy students in relation to the UKRHBI (33.3% agreed; 66.7% strongly agreed), which highlights this PHE tool as potential teaching and learning resource for environmental decontamination and toxicology.

The analysis of these preliminary results would indicate that the training and resources used were effective in providing undergraduate and postgraduate students with some knowledge of environmental toxicology and decontamination to protect humans and the environment in the aftermath of a biological incident, as well as with skills to manage appropriate tools to tailor robust protection and recovery responses. However, it is not clear whether this specialized training will show the same effectiveness to train human health science students with little knowledge on microbiology

and parasitology and toxicology. As a result, we have performed some adjustments to deliver it in the DMU programme BMedSci Medical Science (Hons) in 2016/17 (n=24), as these students do not have a complete module for the study of microbiology and parasitology and their knowledge on toxicology is reduced to clinical toxicology and toxicology of drugs. Details of the BMedSci programme is available at the DMU website here: https://www.dmu.ac.uk/study/courses/undergraduate-courses/medical-science-b-med-sci-hons-degree/medical-science-b-med-sci-hons.aspx

2.2 Training for Medical Science students

The theoretical environmental recovery training to respond to biological incidents (lectures and seminars) and practical training (2 hours research-led workshop), were delivered to final year students enrolled in the module Clinical Perspectives II in 2016/17. Students were provided with all the necessary information and relevant copies of the UKRHBI, including a recording recovery options datasheet and the physiological characteristics table for food production systems appropriately completed for *C. cayetanensis* with the most up-to-date information.

To analyse this training, we distributed the same feedback-questionnaire (Likert scale with open-questions) that was used with the above programmes, *i.e.* Pharmacy and MSc Advanced Biomedical Science. The Research Ethics Committee at DMU granted approval to perform this study (Ref. 1729).

3 RESULTS

BMedSci students that attended the training completed the feedback-questionnaire (15 out of 24). Students reported high levels of enjoyment and satisfaction (Figure 1).

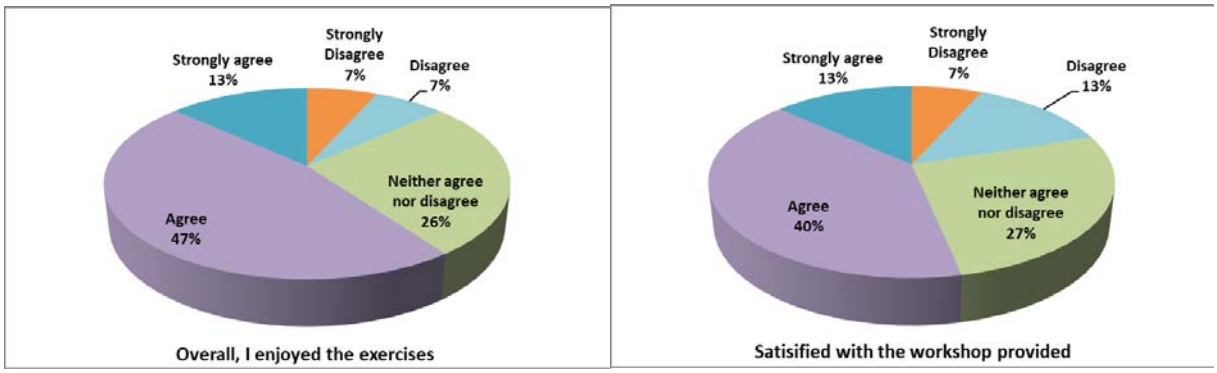

Figure 1. Student enjoyment and satisfaction (%) of the training.

The relatively high dissatisfaction recorded (20%; Fig. 1) could be attributed to the training topic (environmental toxicology and decontamination) which is not clearly related to medicine or public health/environmental science, traditional topics that were not of direct interest for these Medical Science students. However, only a small proportion (6.7%) indicated that the training was not related with the content of their module and/or programme.

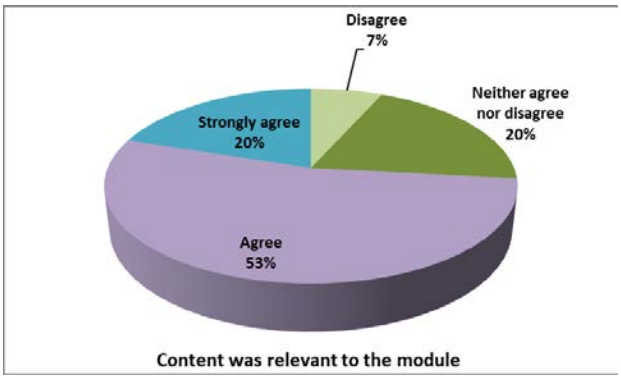

Figure 2. Student's feedback related with to relevance of the training in their programme (%). Absence of a Likert category indicates no responses for that category.

In relation with the learning, students reported the following feedback: 73.3% indicated that they gained some public health prevention/preparedness knowledge against a biological incident (Fig. **3A**); 80% highlighted that they learnt how to establish some public health interventions (Fig. **3B**); 87% reported that they learnt how to investigate an infectious outbreak, which is important to select appropriate protection options (Fig. **3C**); and 60% learnt how to tailor a recovery plan (Fig. **3D**).

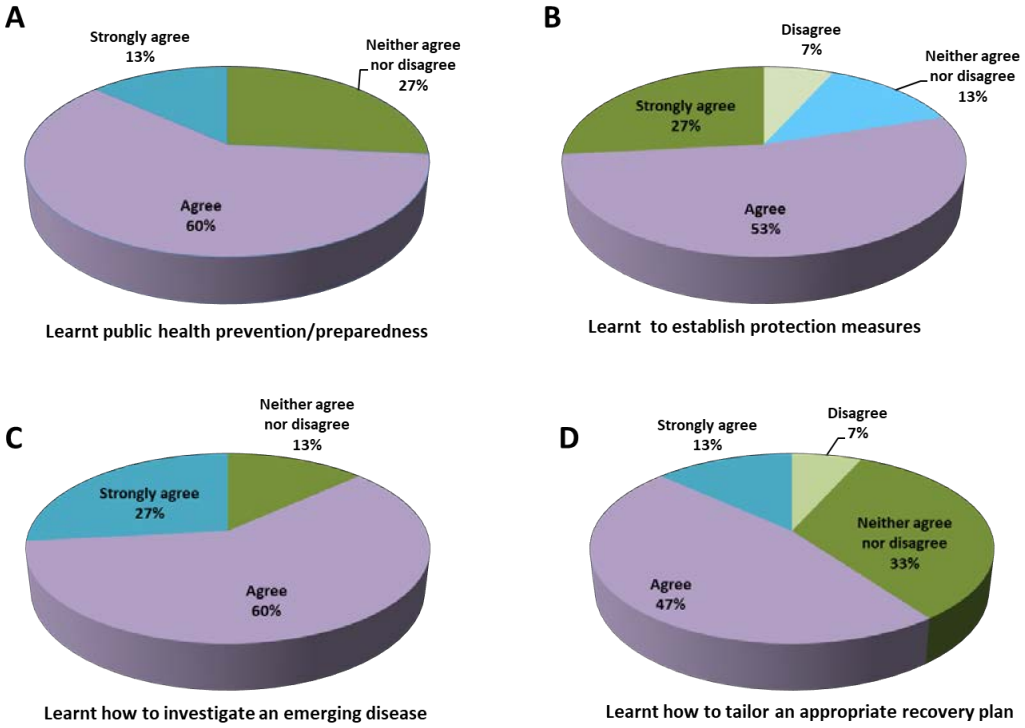

Figure 3. Student's feedback related with the relevance of the training in their programme (%). Absence of a Likert category indicates no responses for that category.

A few students (20%; Figure 4) had difficulties with the recovery concepts and the interpretation of the physiological characteristics, which may be attributed to limited background knowledge of microbiology and parasitology as the Medical Science programme does not have a complete module for studying these topics. However, and importantly, a proportion of students (60% agreed-strongly agreed; 33.3% neither agreed nor disagreed; Figure 5) suggested the incorporation of additional, similar workshops within their programme. This may indicate that despite some students having difficulties with the workshop, they found it interesting, although up to 33% documented that the training would not have any positive impact in their future professions (Fig. 5).

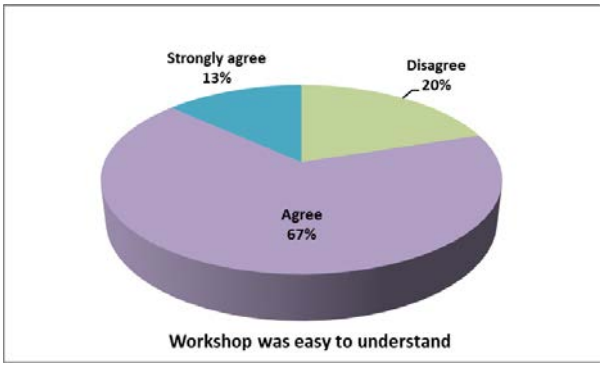

Figure 4. Student's feedback in relation to the difficulty of the training (%). Absence of a Likert category indicates no responses for that category.

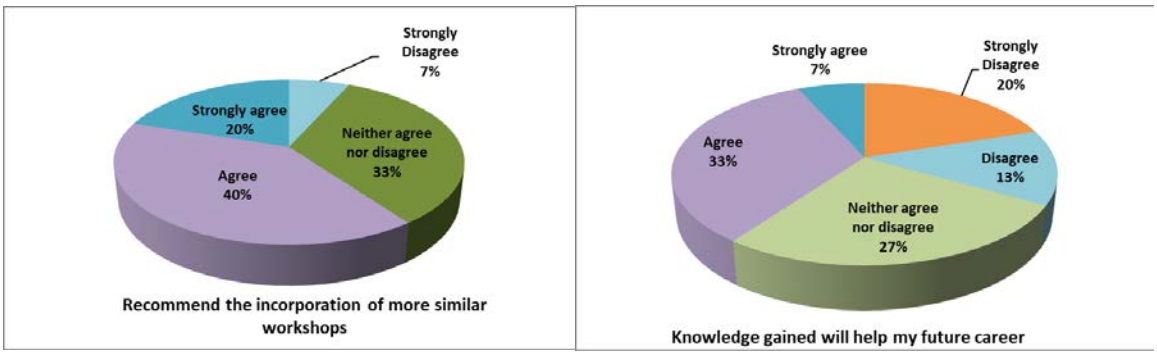

Figure 5. Student's suggestion on the incorporation of more similar workshops in BMedSci programme and perception on the relevance of the training in their future careers (%). Absence of a Likert category indicates no responses for that category.

Finally, only 7% of participants indicated that the UKRHBI aided their learning about environmental decontamination and recovery and helped them to tailor their responses.

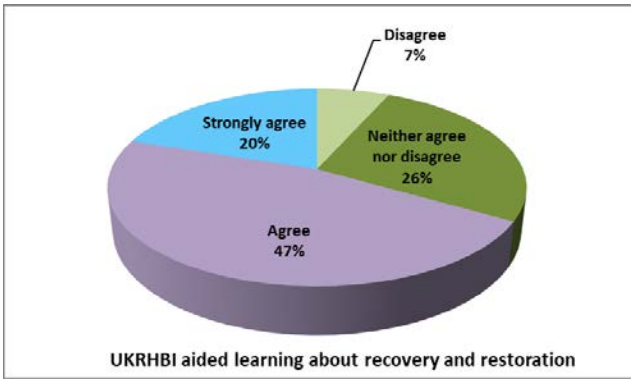

Figure 6. Student's opinion (%) in relation to the UKRHBI (Pottage et al., 2015). Absence of a Likert category indicates no responses for that category.

4 CONCLUSIONS

The analysis of these preliminary results would indicate that the training, although limited in time, would also be effective in facilitating the acquisition, by undergraduate students with limited background in microbiology and parasitology, of some of the basic competences designed to cover the environmental decontamination and protection response in the aftermath of a biological incident. Thus, although more studies are needed, our results could indicate that the UKRHBI designed by PHE, would be an effective tool to tailor appropriate recovery responses even in users with limited medical microbiology background. The increased prevalence of events involving biological hazards and outbreaks of infection necessitates development of appropriate training to include environmental decontamination strategies to protect human health. The training here described could be considered as a successful first step in the development of this crucial training to develop appropriate future health professionals that can act promptly and with scientific rigor and appropriateness in the aftermath of any biological incident to effectively protect human populations.

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