

OpenWHO: Integrating Online Knowledge Transfer into Health Emergency Response

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Abstract. The platform OpenWHO was developed in 2017 in a cooperation between the World Health Organization (WHO) and the Hasso Plattner Institute (HPI). The Department of Infectious Hazard Management, under the WHO Health Emergencies Programme, worked together with the HPI to create a new interactive, web-based, knowledge-transfer platform offering online courses to improve the response to health emergencies. The platform was newly launched as there was an identified need of an open and scalable solution for fast distribution of life-saving content in disease outbreaks for frontline responders. The platform provides adjusted versions of the massive open online learning resources that are self-paced and at ease formats for the frontline and low-bandwidth use. The HPI already developed know-how in previous Massive Open Online Course (MOOC) projects like openHPI and openSAP. OpenWHO is based on the same technology as the aforementioned projects. This paper will provide insights into the practical deployment, the adaption of the MOOC concept, and lessons learnt within the first year of this platform.

Keywords: Health Emergencies, Disease Outbreaks, Epidemics, Frontline Responders, Health Emergency Training, Online Learning, MOOCs

1 Introduction

The nature of hazards and the contexts in which they occur is evolving rapidly in the 21st century. Associated factors include increases in global travel and trade, intense urbanization and persistent poverty in many parts of the world, climate-change-associated natural disasters, unprecedented numbers of migrants and refugees, disparities in access to health services as well as the proliferation of emergency response actors and agencies. No single government, agency or team can manage today's complex epidemics and health emergencies on their own. Emergency response is carried out by local, national and international responders, each of whom has a different background, education and level of knowledge. Recent epidemics have highlighted the need to make quickly available key technical and operational information to thousands of frontline

responders. This rapid and complex knowledge transfer requires a modern, agile and easy-to access platform, well beyond the capacity of conventional websites.

OpenWHO¹ aims to address this need: it transfers the latest and most relevant scientific, technical, and operational knowledge to frontline responders via online courses and knowledge resources for responders. OpenWHO is the World Health Organization's (WHO) first platform to integrate open online learning concepts into emergency response. Successfully launched publicly in June 2017, it now caters to more than 30,000 individual users, targeting frontline health workers. Learning materials are used not only by WHO staff in the field, but also by Member States personnel, such as Ministry of Health officials, other UN and partner organizations, as well as international and national non-governmental organizations. All materials are also educational for the general public, students, travelers and others. The platform is open access and free for all users, with more than 40,000 course registrations from all over the world in the first 9 months since it was launched.

Functioning as WHO's learning platform for emergencies, OpenWHO aims to equip all frontline responders with the knowledge they need to better contain disease outbreaks and manage health emergencies. The flexible and high-capacity online learning platform can provide preliminary training, briefings and knowledge transfer as part of a readiness system for emergency response. Response teams working amid these variables need reliable, up-to-date information on known pathogens and hazards as well as real-time access to briefings about new events, new emergencies, and newly emerging pathogens. Short online courses on 40 topics are available at OpenWHO for practitioners, response teams, volunteers and decision-makers at the frontlines of health emergency and outbreak response. This is made possible by using low-bandwidth technologies and accompanying iOS and Android apps so that life-saving knowledge can be accessed even in the remotest parts of the world. The platform also allows to download different learning elements (video, audio, transcripts) and use them offline.

This article presents one of OpenWHO's experimental practices: training frontline workers for health emergency response prior to deployment with outbreak response related knowledge resources. The essential knowledge and technical guidance related to disease containment is compiled into an easy-to-use online course format, consisting of video, audio and critical source documents. Materials include also some resources in local languages.

1.1 Channels of Information

The WHO uses, amongst others, a website, several apps and social media channels. Following, the listed examples will be described in detail:

- **WHO Website** The WHO website is available in six languages (English, Spanish, French, Russian, Arabic and Mandarin). It contains a large amount of information in form of publications, program overviews, news, reports and facts. Even though it is a great collection of data, it is easy to get sidetracked or lost as the sheer amount of

¹ <https://openwho.org/>

content can be overwhelming. The website is not built to host a large number of visitors simultaneously like it would be the case in a global medical emergency.

- **WHO Info App** The Info App provides access to the latest health information. It contains articles and news about the WHO as well as news about diseases and outbreaks. Articles and reports link back to the WHO website.
- **WHO Social Media** There are several social media appearances of the WHO, like Facebook, Twitter or Instagram. Some share general information about the WHO, some about topics concerning a specific region.
- **WHO Zika App** The Zika App contains the latest information focusing on the Zika virus. It is a lot easier to navigate as it only covers one topic and has a main target audience of health care workers.
- **WHO YouTube Channel** Educational video footage as well as documentations of e.g. health assemblies are published here.
- **WHO Newsletter** Corporate newsletter providing weekly updates to voluntary subscribers across the globe. The newsletter is targeted to general public but is available to anyone wishing to receive up-to-date information on WHO's activities.

The above examples are all applications that serve the purpose of distributing knowledge but have different target audiences. As someone looking for specific information it can be difficult to find the right place to look it up. The OpenWHO team also strives to find suitable ways to reach the right audiences for the platform materials.

1.2 Problem Statement

Based on one year of OpenWHO experience some gaps and issues have been identified. People who are or may become a frontline responder do not necessarily access the materials provided in the organization's internal channels only. Also searching from internet pages can be challenging. The OpenWHO platform was established to enable fast distribution of critical resources in health emergencies and infectious disease outbreaks to a wider audience, including external users. Materials need to be in well-packaged and at-ease-formats for the frontline responders. It has been recognized that in the outbreak response in most vulnerable settings the learning material management and distribution need to correlate with the infrastructures: there is a lack of internet network capacity to load large data size packages. Therefore, the OpenWHO platform and material structure needs to adapt to very varying bandwidth scenarios.

2 Digital Solution

After identifying the presented needs and requirements, WHO's Health Emergencies Programme teamed up with the Hasso Plattner Institute (HPI) from Potsdam, Germany to provide a modern e-learning solution that scales globally. Therefore, HPI's digital learning platform was adapted, to transform the concept of Massive Open Online Courses (MOOCs) into online knowledge transfer for health emergency response. The underlying concepts are introduced in the following sections, which paved the way for the new OpenWHO platform.

2.1 The MOOC Platform of Hasso Plattner Institute

The Hasso Plattner Institute started its efforts in 2012 as the first European MOOC provider [1]. Based on its whitelabel software, multiple MOOC platforms were established, like openHPI, openSAP and mooc.house. Since 2012 the non-profit openHPI² project is developed and maintained by the HPI in Potsdam, Germany. Up today almost 500,000 enrollments are taken in courses with topics mostly derived from the HPI curriculum. Because not all companies or institutions can afford to host an own infrastructure for MOOCs, or their course output is too small for an own platform, the HPI offers the mooc.house platform for external partners. In 2013 the German-based software company SAP launched their openSAP platform for enterprise MOOCs. The primary objective is to enlarge the SAP ecosystem, by offering education and trainings for their employees and external people about their products [2]. The openSAP platform is one of the first enterprise-based MOOC platforms with currently over 2,800,000 course enrollments. It is based on the same software as openHPI.

Next to the responsive web client, all platforms can be accessed with native mobile apps for iOS and Android. These apps follow an offline-first approach, to better enable learning in no- or low-internet scenarios after syncing the data. Being an academic institution, the HPI has a strong research interest regarding MOOCs and its platform. Current research questions focus at the topics learning analytics, team peer assessments, social coding, gamification, game-based learning, mobile and offline learning. Additionally, the openHPI platform uses HPI's tele-TASK³ system for recording lectures, which offers dual stream processing as a handy mobile system.

2.2 The Concept of OpenWHO

OpenWHO aims to meet the evolving needs of frontline responders in the 21st century. Therefore, OpenWHO has adapted and customized the MOOC model based on HPI's digital learning platform in which users can easily access knowledge-transfer materials from anywhere in the world, including hard-to-reach remote areas. Currently, the platform has four thematic channels:

- The **Outbreak** channel provides trainings on epidemiological knowledge and health interventions on infectious diseases like Ebola virus disease, yellow fever or cholera
- The **Ready for Response** channel focuses on trainings required for humanitarian and health emergency responses and includes materials such as introduction to the WHO incident management system
- The **Get Social** channel hosts courses for practitioners in topics related to social science, risk communication and communication essentials
- The **Preparing for Pandemics** channel brings together courses on various aspects of preparedness, including surveillance, public health measures and public health interventions during a pandemic

² <https://open.hpi.de/>

³ <https://tele-task.de/about/>

The platform currently runs self-paced courses. There is no standard length or type of learning resource given the varying need and use of the materials. Most of the materials last 1-3 hours and are short learning resources. The OpenWHO production team can also regularly update courses with the latest disease-specific information through the technical guidance of WHO experts.

Self-assessments in the form of multiple-choice quiz questions also enable users to test their knowledge. Pre-tests gauge what users already know before the lecture and post-tests check what they have learned. For both, users immediately get feedback on their responses after submitting. This platform function can also be used for surveys and questionnaires in instances when the course is used as an online pre-requisite to in-person trainings. The course document center provides access to complete series of presentation slides as well as other WHO guidance materials and knowledge packs. Discussion forums enable users to interact with each other, asking questions and sharing their experience in the field.

OpenWHO also provides a mobile studio based on the tele-TASK recording system, which enables direct downloads from the audio-visual recording system to the platform. This reduces significantly and can abolish completely the need for outsourced content production and dependency on external content producers. The OpenWHO platform and production tools allow the building of interactive courses in-house. This leads to fast content production and the ability to revise any content at any time. The workflow is based on open standards, including small content packages that can be easily produced without a vendor locking. The platform ensures the ownership of content, a fast content production and distribution workflow, a scalable infrastructure and it has a reliable worldwide distribution for critical resources via the use of content delivery networks.

3 Practical Deployment

The following section will present insights into the technical architecture of the platform and adaptations which were implemented for the deployment of OpenWHO. Also, the process of how existing and new knowledge resources are produced and migrated into the platform is explained.

3.1 Technical Architecture

The architecture of OpenWHO is based on independent microservices. Each of them provides its own domain-specific functionality (Figure 1). Several instances of each microservice can be deployed in parallel, making this architecture highly scalable to fit even a large number of users at the same time. The services representing the backend are mostly written in Ruby on Rails – a framework based on the Model View Controller (MVC) principle to separate logic and user-view. All services apart from the Web Service have roughly the same structure: each has its own database to store and organize data. There is no global database accessible by several microservices. Furthermore, each service provides an Application Programming Interface (API) in order to offer

other services their functionality and data. A message queue is available for asynchronous inter-service communication. Additionally, there is a public API that is utilized by the mobile applications and web client.

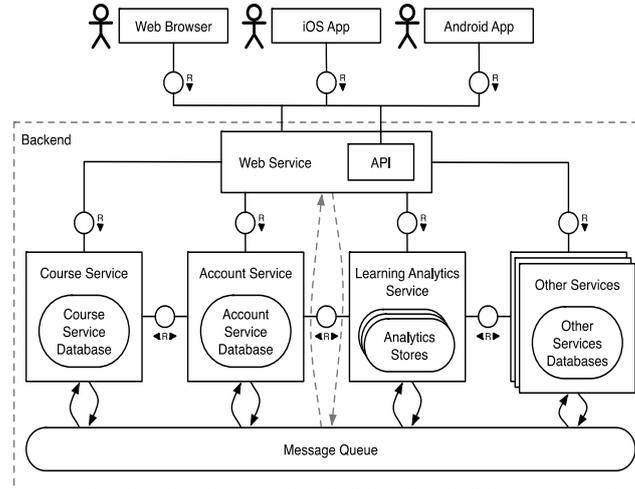


Fig. 1. The Platform's Service-Oriented Architecture

3.2 Platform Adaption

While the purpose of OpenWHO fits great into the world of scalable and cloud-based e-learning, its approach does not overlap completely with the traditional MOOC approach. Nevertheless, the platform can be adapted to those circumstance and can suit different needs. MOOCs often feature a fixed start and end date, and within this duration a synchronized publishing of new content. This leads to a mixture of flexibility (consume the content in small chunks whenever and wherever you want) and structure (fixed deadlines). Furthermore, this leads to social cohorts of learners, who are learning based on the same learning material and therefore can form a social learning community within the forums and the collaboration spaces.

OpenWHO follows a different self-directed learning approach, where all courses are available in a course repository and can be accessed based on the learner's needs. All courses can be accessed through the responsive website or by using the native mobile apps available for Apple and Android devices. While native apps lead to more visibility for users looking for content and solutions within the app stores, they also allow a better support of content consumption in low- or no-internet scenarios. Concerning language barriers, videos can have subtitles to enable access without language barriers. Translations are currently provided manually. In the future, this could be done through automated translations (Section 5).

Also, a new functionality to automatically extract audio files out of the video files was introduced. As audio files only use a fraction of data of video files this allows users with fragile internet access to consume the content. The tele-TASK video player which comes with the platform allows to watch one or two parallel video streams. OpenWHO

also uses the portable tele-TASK production system. In many courses the lecturer is shown in one stream and his presentation on another synchronized stream. The users can arrange the size of the two videos as they like. The video post-production workflow also offers automatic slide detection in the presentation videos – enabling a visual video navigation for the learner. Furthermore, the playback rate can be reduced or accelerated by the learner if necessary.

Live Briefings. New video material and updated content can be published within a few hours, and updated text and documents can be published on the fly. But sometimes it might be needed to have complex information presented on the fly as well. The WHO had some successful live streams on external providers like Facebook, which can lead to possible legal and data privacy issues. Therefore, live streaming has been implemented as new core functionality of OpenWHO. Tests with Microsoft's Azure Media Services and with Vimeo Live have been conducted. Vimeo proved to offer a simpler usability, a much more affordable pricing model and a deeper platform integration.

Document Management. Another new core functionality that was introduced as part of a student project co-innovation process. The document management center is a centralized repository of file-based documents like knowledge packs containing technical guidance documents and other resources. This content can then be maintained and updated, while the referenced documents within the courses are automatically updated as well. The system also allows localized documents, so users can choose which language to access. The binary files are hosted and delivered through the OpenWHO system, thereby external dependencies are avoided.

3.3 Identifying and Compiling Knowledge Resources

One of OpenWHO's experimental practices is the training of frontline workers for health emergency response prior to deployment with emergency knowledge resources. A set of emergency knowledge resources has the following features:

1. It usually consists of an expert video presentation, accompanying a small quiz to test and verify the learning and critical technical advice documents such as knowledge packs, a disease specific guidance document compilation.
2. Most of the materials in the knowledge resources are already in a downloadable format and can be quickly published to support response.
3. In most cases, the publishing cycle takes only few days from the day when an outbreak alert was started.
4. All the presentations are designed to be fit for small screens considering nearly half of the users rely on their mobile devices to access the platform.

For example, the two knowledge resources in response to Ebola outbreak in the Democratic Republic of the Congo (May 2017) and pneumonic plague outbreak in Madagascar (October 2017) provided video lectures that could be viewed online and downloaded in HD and SD format; the audio, transcripts and the presentation of the lectures

can also be acquired through a download function. The process of launching an emergency knowledge resource usually begins with identifying what materials already exist on the platform, which languages are most commonly spoken by the affected communities, and what essential knowledge is needed by responders. Existing materials are then adapted by adding outbreak-specific recommendations (Figure 2).

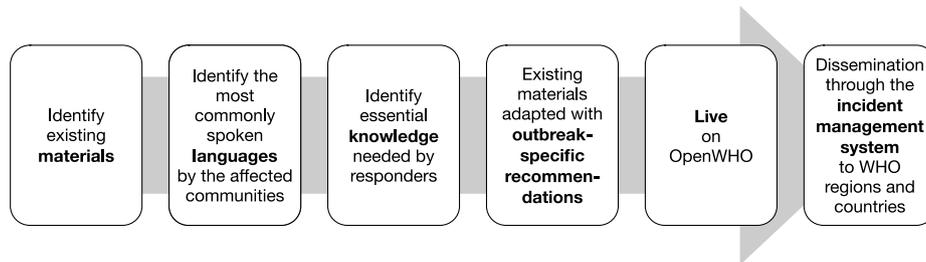


Fig. 2. Production Flow Chart for Emergency Knowledge Resources

Taken the previous two knowledge resources as example, the video lectures were previously conducted as part of the video lectures for the Pandemic and epidemic-prone diseases, one of OpenWHO's earliest courses. Having introductory disease lectures ready ensured a timely adaptation of the learning elements into outbreak-specific resources. OpenWHO has a standing agreement with Translators Without Borders⁴ (TWB) to translate health emergency related materials into local languages. TWB provided continued support translating materials from English or French into local languages spoken by the affected communities. In this case, the translated languages were Lingala (DRC) and Malagasy (Madagascar). Once live, the courses were disseminated through the Incident Management System to WHO regional and country offices. Practitioners can also download the materials or use them offline through the mobile apps.

4 Lessons Learnt in Previous Health Emergencies

The emergency knowledge resources approach was tested during three recent outbreaks: Ebola in Democratic Republic of the Congo in May 2017, pneumonic plague in Madagascar in October 2017, and diphtheria in the Rohingya refugee setting of Cox's Bazar, Bangladesh in December 2017. Worldwide, a record 130 million people are in need of humanitarian assistance, and disease outbreaks are a constant global threat. Knowledge exists for battling many known disease outbreaks, but the challenge is to get the latest science and knowledge into hands and minds of decision-makers and frontline responders. Even more difficult is to capture, package and deliver knowledge on new diseases.

⁴ <https://translatorswithoutborders.org/>

4.1 Key Findings from Recent Outbreaks

This section looks at three case studies from use of OpenWHO learning resources in disease outbreaks. Key findings are gathered from data and statistics and analyzed following these emergency events.

Case Study I: Ebola Outbreak in Democratic Republic of the Congo (May 2017).

In May 2017, two years following the devastating outbreak of Ebola in West Africa, the disease resurfaced in a remote area in Likati Health Zone, Bas Uele Province in the north of Democratic Republic of the Congo (DRC), bordering Central African Republic [3]. Extensive number of WHO’s technical documents and guidance were existing at the time which had to be rapidly adapted to the current geographic and social contexts as well as made more easily accessible and digestible to frontline responders and decision-makers responding to the outbreak. The knowledge dissemination platform of choice was OpenWHO. An online video course with knowledge resources for Ebola responders was launched within days following the onset of the outbreak (the platform was already available in open beta at this time). According to identification of the most commonly spoken languages in the region, it was rapidly translated from English to French and to Lingala, language spoken in the northern parts of DRC. 233 French speaking and 392 English and Lingala speaking Ebola responders participated in the course. According to the data, the course was not only taken by those being deployed to Democratic Republic of the Congo, but also by people in neighboring countries, such as Uganda, Zambia, Tanzania, Cameroon and Rwanda.

When looking at the users (Figure 3) of the Ebola Knowledge Resource can be stated that the course attracts very diverse audience from volunteers and students to national ministries and institutes, United Nations country teams, WHO staff, non-governmental staff and other interested users.

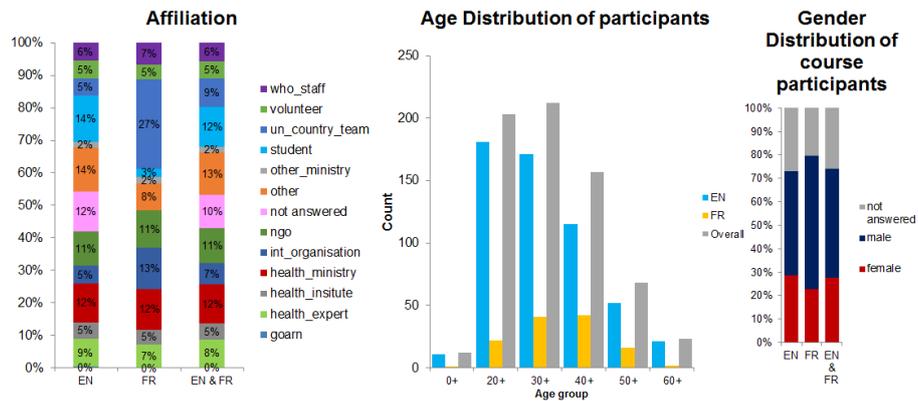


Fig. 3. Ebola Knowledge Resource User Affiliation

Learning from the Ebola response in 2017, the OpenWHO team has developed a learning path for frontline responders and the OpenWHO platform is currently featuring five

learning resources (Figure 4). Ebola virus disease basic introduction and Knowledge resources for responders are provided in three languages: English, French and Lingala.



Fig. 4. Online Learning Path on OpenWHO for Ebola Responders

Case Study II: Pneumonic Plague Outbreak in Madagascar (October 2017). Between 1 August and 22 November 2017, the Madagascar Ministry of Public Health reported a total 2,348 cases of plague, including 202 deaths [4]. Plague occurs seasonally in Madagascar, usually between September and April each year. However, the difference this time was that the outbreak presented itself in a severe pneumonic form as opposed to bubonic form and was hitting densely populated urban areas, including the capital Antananarivo. Given the rapid incubation period of pneumonic plague and the possibility of death within 2-4 days, it was vital to be able to adapt and to disseminate the existing WHO guidance and resources to frontline responders as quickly as possible and in languages they understand.

This need resulted in a multidisciplinary online course in English, French and Malagasy hosted on the OpenWHO platform. The one-hour course focused on refreshing knowledge on transmission cycle of the disease, the difference between bubonic and pneumonic plague, various public health concerns associated with an outbreak of this disease as well as on social aspects, such as building community trust in plague outbreak response. Data shows that 552 people from more than 70 countries took the course during the outbreak, from which 18 were from Madagascar and 26 were from neighboring islands and countries, such as South Africa, Mozambique, Kenya, Seychelles, Mauritius, Reunion and Ethiopia.

Registered users included many public health professionals. For example, in Madagascar, the course was taken by health workers from the Ministry on Public Health, Health for All Foundation, Institute Pasteur Madagascar, Save the Children International and others; students from University of Madagascar as well as partners from UNFPA and UNICEF. The majority of responders were dispatched to the response from other countries and attended the course prior their deployment in their respective countries.

Case Study III: Diphtheria Outbreak in Cox Bazar, Bangladesh (December 2017). In December 2017, respiratory diphtheria was spreading among Rohingya refugees in Cox Bazar, Bangladesh. WHO's Health Emergencies Programme supported the miti-

gation of the crisis through a number of health interventions, including an online learning course on clinical management for diphtheria, hosted on the OpenWHO platform. The 4-hour online course, based on WHO's guidelines, aimed to provide basic information on diphtheria and was targeted for clinicians caring for patients in vulnerable settings, such as that in Cox Bazar, and was applicable to other settings that share similar challenges due to limited laboratory capacity, availability of treatment facilities, lack of trained personnel, medical supplies as well as supportive care.

The WHO response team decided that the best way to transfer knowledge to clinical teams in different parts of the world was to create an online course and host it on the OpenWHO learning platform. The course was launched on the same day as the Emergency Medical Teams (EMTs) were about to board the plane to Bangladesh. 300 clinical experts took the online course during the first month of its launch with majority of enrollments coming from Bangladesh (48), followed by the United States (46), the United Kingdom (35), Yemen (28), India (24) and others. The material has been further translated into Arabic, Bahasa Indonesia, French and Spanish given diphtheria outbreaks in Yemen, Indonesia, Haiti and Venezuela.

4.2 General Findings and Key Challenges

The three knowledge resources were all marketed in a similar manner with a number of key dissemination channels identified for the launch to reach the target audiences and to raise awareness to the ongoing events. The channels included:

- WHO's digital content dissemination channels
- WHO's Incident Management System
- WHO's surge capacity and partner networks
- OpenWHO's email announcements
- Emails to specifically identified target individuals

The accumulative enrollment data in Figure 5 shows a comparison of the numbers of enrollments in the particular knowledge resources during the first 30 days of emergencies response [5]. Day 1 represents the day when the course was launched. In general, all the knowledge resources received a stable increase in the number of enrollments. To be more specific, the Ebola (FR) and Diphtheria received an instant growth in the first 7 days of publishing, while user numbers for the other three courses only started to grow faster on Day 7, followed by a linear increase until Day 30 when the outbreak started to wind down. The number of enrollments in the Diphtheria course slowed down during the second week, but soared dramatically starting from Day 14. It is possible to attribute such strong performance to an increase in user traffic observed from Yemen, possibly due to simultaneous outbreaks in the country.

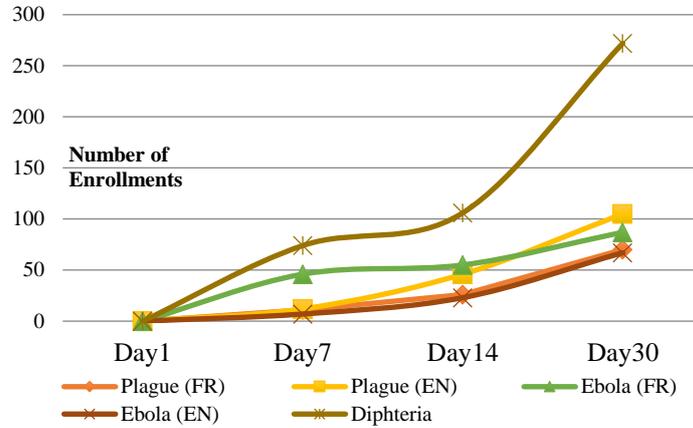


Fig. 5. Number of Knowledge Resource Enrollments during the 30-Day Period after Launch

Initial marketing and dissemination efforts resulted in other public health agencies picking up the information and highlighting it on their own dissemination channels. According to data gathered following the three events, the top 5 course referrer platforms were: social media (2,104), WHO's website (1,581), Disaster Information Management Research Center in U.S. Department of Health & Human Services (1,454), University of Toronto, Department of Global Health (473) and online search (76).

Overall, the usage of emergency knowledge resource on OpenWHO has demonstrated a satisfying level of outreach to the targeted audience. It has proven the possibility of engaging and training a large number of people simultaneously at a reasonably low cost yet with the complexity that any traditional training operation would require. Moreover, the emergency knowledge resource has been proven effective enough as a standard practice to produce and disseminate materials in a timely manner and facilitate feasible quick technical content revision without severe delay or interruption of the dissemination process.

Production of Multi-Language Materials. There are still some factors to be examined in depth, key topic being the local language productions. The need to produce in local health care worker and local populations languages is widely recognized. It is however complex to arrange for language mapping, getting materials translated, which after the content verification has to be completed by a subject matter expert native in the local language and only then to go for material publishing and production in audio or other formats. Yet, another challenge remains to have the online packaged resources communicated to the right focal points for the most efficient use. This process in total can vary between days and weeks and it is crucial for the response to have appropriate materials at the very onset of the disease outbreak. The OpenWHO platform hosts materials in 18 local languages but it will need more automated systems in getting materials into languages, and not only to local languages, but also to produce automated transcripts to arrange faster for any language translations. While the generic production process is

organized in-house at the WHO, there is also a need to arrange for field-based material production, including recording materials on-site. This would require suitable personnel and gear at the frontline. Whereas headquarter-based productions are very cost efficient and work stream is established, it remains yet to be solved how to arrange productions in the distance.

Limited Qualitative User Feedback and Evaluation. The OpenWHO team also has identified a key challenge in acquiring more in-depth user analysis and evaluations. The user insights would help identify the gaps and possible issues in the material formats and use. Currently 30,000 individual users are on average enrolled to 1.5 courses each. This shows that a critical practitioner mass is in the platform and actively engages in the response of various disease outbreaks. The users can discuss on the OpenWHO platform collaboration spaces and ask questions from the experts. Beyond this function there is no established two-way communication between course producers and users yet and no post-mission surveys in place.

Operating in Low-Bandwidth Areas. The courses focusing on the three events were accessed from more than 100 countries, including those experiencing the events. It helped to observe page loading time from different places across the globe and highlighted challenges to be addressed in the future. While the average load time is 8.52 seconds, the data varies greatly from country to country. In Nigeria, the page load time is 34.5% longer than the average, while in India it takes nearly double the time; whereas in countries such as Switzerland, Germany, or United Kingdom people take less than half of the time, namely 4 seconds to load the same page. Improving user performance with limited internet access is a priority and a current research topic in the cooperation with HPI.

5 Future Work

OpenWHO has demonstrated how massive online learning tools can facilitate health emergency response through making open source materials easily accessible to WHO staff and partners. Further research is expected on the effectiveness of an automated translation tool, and a computerized translation of the materials into other languages.

The WHO wants to learn from the forefront of the response but does not yet have a process to collect this feedback. By using data analytics WHO has a lot of operational information on the use of the OpenWHO platform such as the numbers of users which has constantly increased since the launch of the platform. Data also shows that the numbers of users have increased during outbreaks, but OpenWHO does not yet have a system to collect feedback from users after the outbreaks. A survey following 3-6 months after the course completion would need to be developed to measure the impact of the online learning resources at OpenWHO. The numbers of learners are easy to measure, and it can be shown that the numbers have increased during outbreaks, but for example

the actual experience and usefulness have not been measured yet beyond informal discussion amongst the outbreak response staff.

Next to further improvements of the offline capabilities of the mobile apps, like quizzes and audio playlists of videos, it is also planned to partially support offline usage within the web platform. Additionally, a low-bandwidth mode of the video player is work in progress, which combines the presentation slides with the audio file to significantly reduce the needed amount of data [6].

Furthermore, a need to systematically reach out to practitioners and finding new ways for marketing OpenWHO courses is an ongoing area of interest. The OpenWHO applications help in alerting new resources and communicating; and platform announcements work well for existing users. Further analysis on how to target and reach the new and critical users and how to find OpenWHO in the first place is still to be worked on. A search engine optimization is currently in progress and other internet-based solutions would help to better disseminate OpenWHO resources.

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