Mind the Gap: an Analysis of the International Health Regulations (2005) Core Capacities to Respond to Outbreaks in Yemen

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Abstract

Background: there are several states which are unable to implement the International Health Regulations' core capacities to face the urgent public health threats. Yemen is fronting various challenges to response to the recent potential outbreaks and other public health emergencies due to lack of proper strategies and regulations, which are essential to public health security. It has lived under the turmoil of several rounds of internal armed conflict and political instability since 2011. The overall impact of war and conflict on the health system is vividly observable. The aim of this study is to assess the International Health Regulations' core capacities to respond to outbreaks during the conflict in Yemen.

Methods: The study used qualitative data analysis, including desk reviews and in-depth interviews with key informants. This study simulated the World Health Organization's Joint External Evaluation tool to assess the IHR core capacities in Yemen

Result: Based on the result of the assessment (with its three core functions of: Prevention, Detection, and Response), the country showed limited or no capacity to prevent and respond to outbreaks, however, it presented demonstrated or developed capacity to detect outbreaks. This signifies an overall poor IHR implementation in Yemen.

Conclusion: This study shows that there has been poor implementation of IHR in Yemen, therefore, an urgent intervention is highly need to strengthen the implementation of the IHR core capacities in Yemen.

Background

The Global Health Security Agenda describes the proactive and reactive measures, which are needed to protect the global population against acute public health threats^{1,2}. In today's increasingly interconnected world, local public health threats can quickly transform into a Public Health Emergency of International Concern, which in turn can directly impact human lives as well as economic and political stability¹. Currently, there are several States which are unable to implement the International Health Regulations' (IHR) core capacities in the face of urgent public health threats². The failure to implement the IHR core capacities happen in spite of the fact that it has launched to enforce the importance of prioritizing global health security capacity building^{1,3}.

The purpose of the IHR framework is to bring together 196 countries (including all 194 WHO member states) to strengthen global health security⁴. These regulations help achieve global health security by improving several core capacities including human resources, surveillance, laboratory, response, legislation, policy and financing, coordination, advocacy and national focal point communications, preparedness, and risk communication⁵.

The IHR also formats a new responsibility for world states⁶. This is essential for the response to the 21st century's international public health challenges; including response of epidemic-prone diseases of global concern such as cholera, plague, and yellow fever⁵. A major goal of implementation of the IHR framework is to bolster countries' national public health system through the inclusion of an activated disease surveillance system for public health emergencies, many countries failed to achieve this goal⁴. To ensure the effective application of the IHR core capacities, states can participate in a voluntary tool called World Health Organization Joint External Evaluation (JEE) which is used for monitoring, evaluating and to ensure if the countries have the capacity to prevent, detect, and response to the infectious diseases⁷.

In Yemen since the beginning of the war nearly 102,000 died due to direct effect of the war, and 131,000 due to indirect effect of the war on the essential life services like the food and health services according to UN report⁸. The continuing war in Yemen that started in 2011 has affected multiple sectors of life throughout the country, including the social, economic, health, humanitarian, and educational sectors⁹. The direct impact of the breakdown of these essential services on the population has resulted in human suffering due to lack of means for addressing basic needs and health services⁹.

One of the outcomes of the ongoing conflict in Yemen is the deterioration of the health system. Approximately 2.6 million of children under 15 years old are threatened by measles¹⁰. Furthermore, almost 1.8 million children are at risk of malnutrition¹¹. There is a rise in communicable diseases, such as Malaria, HIV, and tuberculosis which results in many Yemeni civilian deaths which could have been treated or easily prevented¹². The already fragile health system was further stressed by a cholera outbreak as well as various types of communicable diseases such as COVID-19 which resulted in an increasingly difficult work environment and an even heavier work-load for healthcare personnel¹³.

The challenges to response to recent potential outbreaks and other public health emergencies in Yemen are primarily due to lack of proper strategies and regulations, which are essential to public health security. Therefore, the present study was vital to identify how the IHR were used and the implications of the framework during the current outbreaks in Yemen.

Methods

Study Design

This study used a combination of qualitative research methodologies to assess the implementation of the IHR (2005) in Yemen by analyzing the country's scores obtained through simulating the Joint External Evaluation (JEE) of the IHR (2005) core capacities along with data obtained through semi structured key informant interviews with public health leaders from the Government, local Non-Governmental Organization (LNGOs) and International Non-Governmental Organizations (INGOs) in Yemen.

Sampling

Purposive sampling was used to select key health informants who are instrumental in implementing IHR (2005) in Yemen to be interviewed. Seventeen key informants were invited to participate via email from the following institutions: Ministry of Public Health and Population (MoPHP) (Four), International Organizations (Seven), independent consultants (Two), the National Central Public Health Laboratories (NCPHL)(two), and Academia (two).

Data Collection

In depth interviews (IDI) were conducted with ten key health informants out of seventeen who were invited to participate in the interview. Selection of the key health informants was based on their association in implementing IHR (2005) in Yemen. Initially, an information sheet and consent form of the study were sent to all the key informants to participate in the interview. After obtaining key informants' consent to participate in this study, the interviews were conducted via Skype and recorded. researchers utilized an IDI guide and took response notes from the participant during interviews. These audio recording and notes were securely saved. The Interview guide was developed specifically for this study. (See supplementary file)

The researcher reviewed the most appropriate document associated with IHR 2005 obtained from MoPHP in Yemen, titled (National action plan of IHR in Yemen). based on the following keywords:

"IHR", "Health Stakeholders", "National health Legislations", "IHR coordination, communication and advocacy", "Quarantines", "Radiological Emergencies", "Chemical Emergencies", "Points of entries", "Risk Communication", "Emergency Response Operations". The documents reviewed not enough to score all the capacities, but the IDI with the instrumental key health informants in combination to the field experience of the researchers in Yemen was useful to score IHR core capacities.

Data Analysis

All the ten interviews were transcribed verbatim in English language by a member of the researcher's team. Each interview was given a special secure number (from one to ten) for anonymity purposes.

Interview transcripts were analyzed manually using qualitative content analysis¹⁴. Four data analysis steps were followed, in order to gain insight into the key informants' perceptions of the implementation of the IHR (2005) in Yemen. First, the interpretation of the data by reading each transcript and underlining statements. Second, all underlined statements were coded across each interview undergoing inductive analysis. Third, all codes were grouped into two themes: positive perceptions and negative perceptions. Finally, all statements in both themes were read to reflect the overarching key health informant's perceptions about the implementation of the IHR (2005).

The technical areas in the resulted table were classified according to core functions "Prevent (P)", "Detect (D)", and "Response (R)", in addition to International related hazard (Chemical emergencies (CE), Radiological Emergencies (RE)) and Point of Entries (PoE). The qualitative data analysis was done by using the key informants' quotes to develop color scoring for the indicators of IHR core capacities based on World Health Organization's JEE tool which developed to evaluate the IHR core capacities globally.

The JEE tool color scoring for the core capacities indicators is designed in the form of a five-number scale (1,2,3,4 and 5), with specific color codes (Red, Yellow, and Green) given to each score as shown in Table 1 below. In total, this study evaluated 49 indicators, and assigned color-coded scores in line with the pre-existing system acknowledged and in use by the WHO. The detailed interpretation of the of the color coded scoring system is as follows:

1. No capacity: Means there is no capacity in place for implementing IHR. Color Code: Red
2. Limited Capacity: The capacity is in its development stage (some tasks have been achieved, and some are in the process); overall, the country has started the process of implementation. Color Code: Yellow.
3. Developed capacity: The attributes of capacity are in Place, though, there is an obstacle in its sustainability due to various challenges (e.g. funding shortages). Color Code: Yellow.
4. Demonstrated Capacity: The attributes of the capacity are in place, though, it is sustainable for few more Years, and can be measures by IHR core capacity in the national health regulation plan. Color Code: Green
5. Sustainable Capacity: Core capacities are sustainable, functional, and the country is supporting other countries in implementing IHR, this is the highest level of achievement in the implementation of the IHR core capacities. Color Code: Green

Finally, the developed color scoring assessment was shared with three national IHR experts in Yemen and one international IHR expert for validation.

Results

Table 1 shows the assessment of the IHR core capacities in Yemen based on the World Health Organization's JEE tool. Most indicators of the IHR core capacities scored less or equal to 4 (demonstrated capacity). Seventeen out of 49 indicators were classified as no capacity, eighteen indicators were listed under the limited capacity, six indicators were listed as developed capacity, and eight indicators were classified as demonstrated capacity. There were no indicators scored as sustainable capacity.

Table 1
IHR Core Capacities Scoring - Yemen – 2019*

Technical Area	Core function	Indicator	Score
National legislation, policy and financing IHR coordination, communication and advocacy Antimicrobial Resistance Zoonotic Food Safety Biosafety and biosecurity Immunization	Prevention	P.1.1 Legislation, laws, regulations, administrative requirements, policies or other government instruments are in place and they are sufficient for implementation of IHR	2
		P.1.2 MoPHP can demonstrate that it has adjusted and aligned its domestic legislation, policies and administrative arrangements to enable compliance with IHR	1
		P.2.1 Functional mechanism is established for the coordination and integration of relevant sectors in the implementation of IHR	2
		P. 2.2 Mechanisms for multi-sectoral collaboration are established to ensure rapid response to outbreaks	3
		P.3.1 Antimicrobial resistance (AMR) detection	2
		P.3.2 Surveillance of infections caused by AMR pathogens	1
		P.3.3 Health care associated infection prevention and control programs	2
		P.3.4 Antimicrobial stewardship activities	1
		P.4.1 Surveillance system in place for priority zoonotic diseases/Pathogens	2
		P.4.2 Veterinary or animal health workforce	2
		P.4.3 Mechanisms for responding to zoonoses and potential zoonoses are established and functional	1
		P.5.1 Mechanisms are established and functioning for detecting and responding to food-borne diseases and food contamination	1
		P.6.1 Whole-of-government biosafety and biosecurity system is in place for human, animal, and agriculture facilities	2
		P.6.2 Biosafety and biosecurity training and practices	4
		P.7.1 Vaccine coverage (measles) as part of national program	3
		P.7.2 National vaccine access and delivery	2
National laboratory System Real-time surveillance Reporting Workforce development	Detection	D.1.1 Laboratory testing for detection of priority diseases	4
		D.1.2 Specimen referral and transport system	4
		D.1.3 Effective modern point of care and laboratory- based diagnostics	3
		D.1.4 Laboratory quality system	3
		D.2.1 Indicator- and event-based surveillance systems	4
		D.2.2 Interoperable, interconnected, electronic real-time reporting system 2	4
		D.2.3 Integration and analysis of surveillance data 3	4
		D.2.4 Syndromic surveillance systems	1
		D.3.1 System for efficient reporting to WHO, FAO and OIE	4
		D.3.2 Reporting network and protocols in the country	2
		D.4.1 Human resource available to implement IHR core capacity requirements	3
		D.4.2 FETP1 or other applied epidemiology training program in place 1	4
		D.4.3 Workforce Strategy	1
Preparedness Emergency response operations Linking Public health and security authorities	Response	R.1.1 National multi-hazard public health emergency preparedness and response plan is developed and implemented	1
		R.1.2 Priority Public Health risks and resources are mapped and utilized	1
		R.2.1 Capacity to activate emergency operations	2
		R.2.2 EOC operating procedures and plans	2
		R.2.3 Emergency operations program	2
		R.2.4 Case management procedures are implemented for IHR-relevant hazards	1
		R.3.1 Public health and security authorities (e.g. Law enforcement, border control, customs) are linked during a suspect of confirmed biological event	2

Technical Area	Core function	Indicator	Score
Medical countermeasures and personal deployment		R.4.1 System is in place for sending and receiving medical countermeasures during public health emergency	1
		R.4.2 System is in place for sending and receiving public health personal during public health emergency	1
Risk communication		R.5.1 Risk communication system (plans, mechanisms, etc.)	3
		R.5.2 Internal and partner communication and coordination	2
		R.5.3 Public Communication	2
		R.5.4 Communication engagement with affected communities	2
		R.5.5 Dynamic listening and rumor management	1
International related hazard	Point of Entry	PoE.1 A Routine capacity established at points of entry	2
		PoE.2 Effective public health response at PoE	2
	Chemical Events	CE.1. A Mechanisms established and functioning for detecting and responding to chemical events or emergencies	1
		CE.1. B Enabling environment in place for management of chemical events	1
	Radiation and nuclear emergencies	RE.1.A Mechanisms established and functioning for detecting and responding to radiological and nuclear emergencies	1
		RE.1.B Enabling environment in place for management of radiation emergencies	1
* Score 1 ; No capacity; score 2 : Limited capacity; score 3 : Developed capacity; score 4 : Demonstrated capacity; score 5 : Sustainable capacity.			

Prevention

There are sixteen prevention indicators in this study. Five of the indicators showed no capacity (for example, P.3.4 Antimicrobial stewardship activities), eight indicators showed limited capacity (for example, P.7.2 National vaccine access and delivery), two indicators showed developed capacity (P.7.1 Vaccine coverage (measles) as part of national program), and one indicator showed demonstrated capacity (P.6.2 Biosafety and biosecurity training and practices) as extracted from the key informants;

"There is an immunization program in the country at the governorate level, which was implemented in 1979 and is one of the oldest national programs in Yemen. It follows the policy of immunization through a university committee called the Immunization Technical Advisory Group on a regular basis, which organizes the standard of vaccination and has right to decide to publicly administer a new vaccine or not". **Key Informant 4**

"...As I told you we do not do this training only for the field epidemiology training residents, but also we invited the main hospital and the infection control. We invited directors of PoE. We trained almost 200 people on biosafety and biosecurity, IHR, and outbreak investigations and we also involved the rapid response team in this training..." **Key Informant 9**

Detection

Detection core function showed high capacity. Only two indicators showed no capacity (for example: D.4.3 Workforce strategy), one showed limited capacity (D.3.2 Reporting network and protocols in the country), three showed developed capacity (for example: D.1.4 Laboratory quality system), and seven indicators out of the thirteen detection indicators showed demonstrated capacity (for example: D.2.3 Integration and analysis of surveillance data).

"Currently there is operationalized plan to extend the NCPHL to an additional four governorates in Yemen (Hajja, Sada'a, Amran and Al.Dhale) and the funds and human resources are in place[...]. There is a serology department for Human Immunodeficiency Virus (HIV), Hepatitis B Virus (HBV), Hepatitis C Virus (HCV), Cytomegalovirus (CMV), Dengue Fever, measles, Rubella, Rotavirus and a microbiology department for microbiological and, biological samples, in addition to urine and stool culture. Regarding the poliovirus, we do not have the reagents". **Key Informant 10**

"There is an integrated committee between the NCPHL and Ministry of Public Health and Population specifically during the epidemics, and every week they conduct a meeting to share the data". **Key Informant 4**

"There is an electronic surveillance system for all the suspected cholera cases which is reported in the line list, and then a daily report is raised [...]" **Key Informant 3**

Response

The response core function appeared with low capacity. Fourteen indicators were covered in this evaluation, six indicators showed no capacity (for example: R.1.2 priority public health risks and resources are mapped and utilized), seven showed limited capacity (for example: R.2.1 capacity of active emergency operations), and one indicator showed developed capacity (R.5.1 Risk communication system (plans, mechanisms, ect.).

"The strategies for any health emergency in Yemen are based upon the occurrence of the crisis, without any previous plan in place. We are only distributing duties among the staff at the same time of outbreak (ad-hoc based)". Key Informant 4

Two indicators of radiological emergencies (for example: enabling environment in place for management of radiation emergencies) and two indicators of chemical events (for example: enabling environment in place for management chemical events) showed no capacity, two indicators of PoE showed limited capacity (for example: effective public health response at PoE).

Discussion

The findings of this study demonstrate poor implementation of the IHR (2005) core capacities. The results indicate that Yemen has a high capacity in detection core function and low capacity in response and prevention core functions see Fig. 1. Yemen signed the agreement for IHR implementation in 2006, however, the implementation of IHR continues to face intractable challenges. As consequences of the ongoing war in Yemen, the essential infrastructure and health systems have collapsed that aggravated the spread of several communicable diseases, including cholera, diphtheria, dengue and COVID-19¹⁷. In addition, there has been inappropriate planning for the consumption of funds and resources for IHR implementation. In this context, the bureaucratic systems of the international community and current political situation make it difficult to support MoPHP to implement the IHR core capacities financially. For instance, a study conducted in Tanzania suggested that insufficient budget allocation for IHR implementation is one of the main challenges to implement IHR¹⁸. Despite the availability of national qualified academic staff at MoPHP who can develop essential guidelines for management of the epidemic diseases in the country, however, the essential financial supports were not allocated to develop and implement guidelines and legislation this finding is in agreement with similar findings of the JEE evaluation conducted in Somalia in 2016¹⁹.

This study identified several obstacles for implementing the risk communication core capacity, including deteriorating infrastructure, difficult transportation, and no electricity to spread health education and awareness messages. Furthermore, there is a lack of administrative resources for risk communication activities, which should be in place before an outbreak take place²⁰. On the other hand, the INGOs depend on their own guidelines, protocols and strategies to implement their agendas and interventions which are not aligned with the national strategies of MoPHP. This indicates the complete disassociation between MoPHP and INGOs agendas, and reflect the fragmentation in implementing the global agendas on the ground.

The "detection" core function indicators scored at the level of "developed capacity" which reveals the best practices and strengths of the health system in Yemen in terms of implementing good tools for detection of the epidemics in the region such as cholera and diphtheria. For example, MoPHP uses electronic Disease Early Warning System (eDEWS) an important tool for early detection of outbreaks²¹. Another important point related to the success of eDEWS is implementing this system in the NCPHL for sharing the confirmed diagnoses of cholera cases and other epidemics. Having this tool within a collapsed health system is considered a great achievement in the midst of extended war in Yemen²². In contrast, the real time surveillance system in Somalia, is very weak and there is almost no capacity¹⁹. Iraq the surveillance system is between "limited capacity" to "developed capacity" since there is a system in place for detecting diseases²³.

Furthermore, Yemen Field Epidemiology Training Program represented a strong applied field epidemiology-training program for workforce development from 2011 to present that also played a key role in detection through outbreak investigation. Several cohorts of field epidemiologist have graduated and filled the gap in epidemiology in terms of field investigation, data analysis and reporting to higher-level decision makers. This explains the continuous efforts towards strengthening detection core function in Yemen²³⁻²⁶. Regarding to the point of entries, results showed limited capacity in Yemen, similar situation was noticed in Somalia and Iraq^{19,20,23}.

There is no well-established network for building the risk communication capacity, which is under the response core function and prioritization, increasing awareness about the danger of epidemic diseases in the region. There is also no developed, formalized system for tracking rumors and misinformation, which is highly needed in the current context of Yemen particularly during the COVID-19 outbreak. A similar finding was in Iraq which showed almost similar scores to Yemen reflecting the effect of political instability on the development of systems for rumor and misinformation tracking²³.

Despite INGOs in the country that are making great efforts in terms of response to current public health crisis, there is still weak coordination and communication between MoPHP and the related stakeholders. The development of a new cholera taskforce for response to the ongoing cholera outbreak in the country showed fluctuation and fragmentation in coordination and operationalization of the emergency plan as seen during the preparedness for COVID-19²⁰.

Immunization is a strong prevention program globally, and has been estimated to prevent approximately two million deaths per year globally²⁷. However, national vaccine access and delivery in Yemen is still facing a variety of obstacles amidst the conflict, the results of this assessment showed developed capacity in the vaccination coverage and limited capacity in national vaccine access, similarly as in Iraq²⁸.

Although the detection in Yemen demonstrates high capacity, the core capacities which are essential for prevention and response scored between no capacity and limited capacity, indicating weakness in prevention and response in Yemen. Similarly, an obvious weakness in prevention was noticed in Iraq and Somalia^{20,23}. In the zone of response core function, all three countries showed low response. The lowest response capacity in Yemen despite good detection may indicate that despite good workforce capacity, the response is mainly hindered by poor financial resources, and lack of response framework that are essential for response especially at the grassroots level.

Conclusion

Developing countries, especially those in the midst of conflict, are expected to suffer from inability to implement the IHR 2005. Conflict affects various aspects of communication, coordination and advocacy between the responsible agencies. In order to protect the global population from acute public health threats, there is an urgent need to stop the current war and strengthen the health system and support the implementation of the core capacities of IHR in Yemen.

Abbreviations

CE: Chemical emergencies

eDEWS: electronic Disease Early Warning System

IHR: International Health Regulations

JEE: Joint External Evaluation tool

MoPHP: Ministry of Public Health and Population

NCPHL: National Central Public Health Laboratories

RE: Radiological Emergencies

PoE: Point of Entries

Declarations

Ethics approval and consent to participate:

The study is in line with the Declaration of Helsinki 2008 looking at getting ethical clearance, informed consent, ensuring privacy and confidentiality of the research participants, and also covering the risk and the benefits of the research to the participants 15,16. Ethical clearance to conduct the study was sought from the Ethical Committee of the Ruprecht Karls Universität Heidelberg (S-172/2019). Individual verbal and written informed consent were also sought and obtained from the participants.

Consent for publication:

Consent was obtained from the Participants to publish their quote anonymously.

Availability of data and materials:

The data was obtained from the IDI with the participants are available upon to request.

Competing interests:

The authors declare that they have no competing interests.

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Authors' contributions:

HN is the principle investigator contributed in all the research process, particularly data collection, data analysis, and writing the first draft of this manuscript. FD contributed in review and draft of the manuscript. AA participated in qualitative data analysis and review the result.

IA contributed in review the draft of the manuscript. TH was involved in data collection. AJ was contributed in the design and review the draft of the manuscript.

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References

1. Katz, R. and C.J. Standley, Regional approaches for enhancing global health security. BMC Public Health, 2019. 19(S3).
2. Aldis, W., Health security as a public health concept: a critical analysis. Health Policy and Planning, 2008. 23(6): p. 369-375.
3. Menon, A.N., E. Rosenfeld, and C.A. Brush, Law and the JEE: Lessons for IHR Implementation. Health security, 2018. 16(S1): p. S-11-S-17
4. WHO. International Health Regulations (2005): Areas of work for implementation. 2007 [cited 2019 5 July]; Available from: https://www.who.int/ihr/publications/areas_of_work/en/.

5. Ijaz K, Kasowski E, Arthur RR, Angulo FJ, Dowell SF. International Health Regulations—What Gets Measured Gets Done. *Emerg Infect Dis.* 2012;18(7):1054-1057. <https://dx.doi.org/10.3201/eid1807.120487>
6. Philippe Calain, From the field side of the binoculars: a different view on global public health surveillance, *Health Policy and Planning*, Volume 22, Issue 1, January 2007, Pages 13–20, <https://doi.org/10.1093/heapol/czl035>
7. WHO. Development of a draft five-year global strategic plan to improve public health preparedness and response. 2017 [cited 2019 22 July]; Available from: https://www.google.de/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&ved=2ahUKEwiujMKUrbjAhWLJFAKHbA3C3sQFjABegQIAhAC&url=http%3A%2F%2Fwww.wpro.who.int%2Fabout%2Fregional_committee%2F68%2Fdocuments%2Fwhe_cpi_ihr_5_year_global_strategic_plan.pdf&usg=AOvVaw0hVcocTWwNBY9zApdomlYJ.
8. UNDP. Assessing the Impact of War on development of Yemen. 72 (2019). [Cited Aug, 2020]; Available from: <https://www.undp.org/content/dam/yemen/General/Docs/ImpactOfWarOnDevelopmentInYemen.pdf>
9. El Bcheraoui, C., et al., Health in Yemen: losing ground in war time. *Global Health*, 2018. 14(1): p. 42.
10. UNICEF. Evaluation of the UNICEF level 3 response to the cholera epidemic in Yemen: A crisis within a crisis. 2018 [cited 2019 3 July]; Available from: <https://www.google.de/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=2ahUKEwidjo2ikubjAhWlqQKHe1hB94QFjAAegQIABAC&url=https%3A%2F%2Fwww.unicef.org%2Fevalda001.pdf&usg=AOvVaw3RR3iyrCHCMvP4s2menh-a>.
11. AA Alamodi, AM Eshaq, AM Fothan, AM Bakather, AS Obad. Tackling preventable diseases in Yemen. *Lancet*, 386 (2015), pp. 2251-2252.
12. The Lancet, Yemen's silent killers. *The Lancet*, 2017. 389(10070).
13. Kuna, A. and M. Gajewski, Cholera - the new strike of an old foe. *Int Marit Health*, 2017. 68(3): p. 163-167.
14. Kohlbacher, F. The use of qualitative content analysis in case study research. in *Forum Qualitative Sozialforschung/Forum: Qualitative Social Research*. 2006. Institut für Qualitative Forschung.
15. World Medical Association. WMA Declaration of Helsinki – Ethical Principles for Medical Research Involving Human Subjects. 2013 [cited 2019 25 March]; Available from: <https://www.wma.net/policies-post/wma-declaration-of-helsinki-ethical-principles-for-medical-research-involving-human-subjects/>.
16. WMA, World Medical Association Declaration of Helsinki. Ethical principles for medical research involving human subjects. *Bulletin of the World Health Organization*, 2001. 79(4): p. 373-374.
17. Dureab F, Shibib K, Al Yousufi R, Jahn A. Yemen: Cholera outbreak and the ongoing armed conflict. *Journal Infect. Dev. Ctries.* 2018; 12(5):397-403. <https://doi.org/10.3855/jidc.10129>
18. WHO. Joint External Evaluation tool (JEE tool) first edition. 2016 [cited 2019 6 June]; Available from: https://www.who.int/ihr/publications/WHO_HSE_GCR_2016_2/en/.
19. WHO. Joint External Evaluation of IHR Core Capacities of the Republic of Somalia. 2016 [cited 2019 28 July]; Available from: <https://www.who.int/ihr/publications/WHO-WHE-CPI-2017.17/en/>.
20. Dureab F, Al Awlaqi S, Jahn A. COVID-19 in Yemen: preparedness measures in a fragile state. *Lancet Public Health*. 2020; DOI: [https://doi.org/10.1016/S2468-2667\(20\)30101-8](https://doi.org/10.1016/S2468-2667(20)30101-8)
21. Dureab, F., et al., Cholera Outbreak in Yemen: Timeliness of Reporting and Response in the National Electronic Disease Early Warning System. *Acta Inform Med*, 2019. 27(2): p. 85-88.
22. Ahmed K., Altaf M.D., Dureab F. Electronic Infectious Disease Surveillance System during Humanitarian Crises in Yemen. *Online J Public Health Inform.* 2014;6(1): e134. Published 2014 Apr 29. doi:10.5210/ojphi.v6i1.5083
23. WHO. Joint External Evaluation of IHR Related core capacities of Republic of Iraq. 2019 [cited 2019 28 July]; Available from: <https://www.who.int/ihr/publications/WHO-WHE-CPI-2019.61/en/>.
24. Al Serouri, A., A. Jumaan, and A. Alkohani, Yemen field epidemiology training programme: a tool for strengthening the public health workforce. *East Mediterr Health J*, 2018. 24(9): p. 905-913.
25. Al Serouri, A., <The role of field epidemiology in the disaster - Yemen Cholera outbreak Example.pdf>. 12 September 2017.
26. Yemen FETP. Y-FETP Launches its Fourth Cohort of Advanced Field Epidemiology Training. 2017 [cited 2019 18 July]; Available from: http://emphnet.net/?country_programs=yemen-fetp.
27. WHO. Joint external evaluation of IHR Core Capacities of the Republic of South Sudan. 2017 [cited 2019 28 July]; Available from: <https://www.who.int/ihr/publications/WHO-WHE-CPI-REP-2018.4/en/>.
28. Gaafar, T., E. Moshni, and F. Lievano, the challenge of achieving measles elimination in the Eastern Mediterranean Region by 2010. *Journal of infectious diseases*, 2003. 187(Supplement_1): p. S164-S171.

Figures

Figure 1

Implication of IHR Core Capacities Color Scoring - Yemen 2019

Figure 1

Implication of IHR Core Capacities Color Scoring - Yemen 2019

Supplementary Files

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