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Manuscript

Study protocol: Building an evidence base for epidemiology emergency response, a mixed methods study.

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List of abbreviations:
IHR - International Health Regulations
EPIET - European Programme Intervention Epidemiology Training
FETP - Field Epidemiology Training

FIFO - fly-in-fly-out
GOARN - Global outbreak alert and response network
IHR – International Health Regulations
MAE - Master of Applied Epidemiology
MSF - Médecins Sans Frontières
PI - Principal Investigator
TEPHINET - Training Programs in Epidemiology and Public Health Interventions Network
US CDC - United States Centers for Disease Control and Prevention
WHO - World Health Organization

Abstract

Introduction: Determinants and drivers for emergencies such as political instability, weak health systems, climate change, and forcibly displaced populations, are increasing the severity, complexity and frequency of public health emergencies. As emergencies become more complex, it is increasingly important that the required skillset of the emergency response workforce is clearly defined. To enable essential epidemiological activities to be implemented and managed during an emergency, a workforce is required with the right mix of skills, knowledge, experience, and local context awareness. This study aims to provide local and international responders with an opportunity to actively contribute to the development of new thinking around emergency response roles and required competencies. In this study, we will develop recommendations using a broad range of evidence to address identified lessons and challenges so that future major emergency responses are culturally and contextually appropriate, and less reliant on long-term international deployments.

Method and analysis: We will conduct a mixed methods study using an exploratory sequential study design. The integration of four data sources, including key informant interviews, a scoping literature review, survey, and semi-structured interviews will allow the research questions to be examined in a flexible, semi-structured way, from a range of perspectives. The study is unequally weighted, with a qualitative emphasis. We will analyse all activities as individual components, and then together in an integrated analysis. Thematic analysis will be conducted in NVivo11 and quantitative analysis will be conducted in Stata15.

Ethics and dissemination: All activities have been approved by the Science and Medical Delegated Ethics Review Committee at the Australian National University (protocol numbers 2018-521, 2018-641, 2019-068). Findings will be disseminated through international and local deployment partners, peer reviewed publication, presentation at international conferences and through social media such as Twitter and Facebook.

ARTICLE SUMMARY

Strengths and limitations of this study

1. This study is addressing a critical knowledge gap. The evidence in this area remains weak with few scientific studies; preliminary stakeholder consultation supported the need for more evidence to inform best practice.
2. This study will build evidence to guide deployment and collaboration of the local and international epidemiology workforce that will enhance the effectiveness of the epidemiology response during future emergencies. The iterative approach will support the research to explore both convergent and divergent findings in greater depth.
3. We expect a diversity of respondents with a range of perspectives which will improve our ability to understand lived realities and experiences in a multidimensional way.
4. Qualitative interviews with international responders will be limited to English. Translation will be offered if English is not interviewee's native language. While we anticipate the sample will be multinational, we acknowledge this as a limitation.

Box 1: Terms used in this study

Epidemiological role: a person who participates in surveillance, response, and disease investigation and control activities during an emergency.
Epidemiology responder: a person working in an epidemiological role during an emergency response, they may or may not be a citizen of the country they are responding within.

INTRODUCTION

Emergencies do not discriminate; they can happen at any time, in any country. Whether they are a natural hazard such as a flood or cyclone, an infectious disease outbreak, or domestic or regional instability, any serious disruption of community functioning may lead to a situation where the ability of the affected community to manage using its own resources is exceeded.(1) The International

Health Regulations (IHR) are a legal instrument that defines the rights and obligations of countries regarding infectious disease surveillance, alert, and response.(2) Countries signatory to the IHR, regularly evaluate their capacity as outlined in the IHR;(2) IHR evaluations have identified that few countries have met the minimum standard.(3,4) One core IHR capacity is related to workforce, the routine evaluations have identified that there is still much work to be done to achieve resilient health systems with a strong local workforce capable of responding to public health emergencies.(5)

Emergency response requires collaboration between many professions; epidemiologists are generally recognised as a core contributor. The primary role of the epidemiology emergency response workforce is to ensure the health and safety of the affected population through the minimization of mortality and morbidity.(6,7) This is achieved through a number of activities including establishing, monitoring and/or early warning surveillance systems, using multiple sources of data and information to conduct risk assessments, rapidly, efficiently and effectively initiating investigation and control activities, and providing information for decision-making.(6–8)

This study will seek to define the epidemiological roles and required competencies of both the international and local epidemiology workforce during emergency response.

Study rationale

Internationally, the determinants and drivers for emergencies such as political instability,(8) weak health systems, (5,9) climate change, (10,11) and forcibly displaced populations,(12) are increasing in severity and frequency.(4) Emergencies are becoming protracted and more complex;(4,8,13–16) this has implications for emergency response management and the required emergency response workforce. To enable essential epidemiological activities to be implemented and effectively managed during an emergency, a workforce is required with the right mix of skills, knowledge, experience, and local context awareness.

When emergencies exceed local workforce capacity, support may be required in the form of the international emergency response workforce.(3) Gostin and Friedman in their 2015 review of the West African Ebola response identified that there was a need to refine who is deployed and to certify the competencies of the public health emergency response workforce.(9) Although the international workforce are used to fill technical needs, many factors affect their usefulness. Responders without the necessary leadership, technical, cultural, or communication skills can limit the effectiveness of the response, drain limited resources, and potentially cause harm.(17,18) The short-term fly-in fly-out (FIFO) nature of international emergency responders means high and rapid staff turnover, which can lead to issues with continuity of response,(19) institutional knowledge loss,(19) and inconsistent support for local responders.

Examining the international epidemiology workforce role is only one part of the picture. Local epidemiology workforce knowledge and context understanding is essential to ensuring the effectiveness of emergency response.(20,21) Previous healthcare professional research has identified the lack of engagement and training of local responders during emergency response as problematic.(17) Supporting the local workforce throughout an emergency can contribute towards local workforce upskilling, continuity of essential work, and reduce the impact of international staffing rotations.(19) Vignettes found in the literature support the value of capacity building of the local workforce during an emergency,(20,22–26) however the evidence for best practice remains weak due to few scientific studies particularly focused on this area.

Checchi et al highlighted the absence of formal professional certification for professionals during emergencies.(27) Work has been started for certification of medical personnel during emergencies,(27,28) however, this has not yet been initiated for other public health professions. Emergency response organisations, such as the World Health Organization (WHO) and Médecins Sans Frontières (MSF), aspire to similar values of technical excellence and professionalism.(29–31) This study will build evidence on what technical excellence and professionalism looks like for the epidemiology

workforce during emergencies. Clarity on roles and competencies required during international emergency response will support adequate preparation prior to deployment of international responders.(17,18) New thinking is needed to identify how local and international responder collaboration and upskilling can strengthen the effectiveness of an emergency response. Development of this knowledge will increase the cultural and contextually appropriate nature of response as well as facilitate less long-term reliance on the international workforce.(20)

Study questions

We conducted a stakeholder consultation in 2018 with five international emergency response and global health agencies. This consultation aimed to identify needs in emergency response research and needs according to these emergency response agencies. The findings of this consultation, combined with the reviewed literature, framed the development of our research questions.

We aim to answer three questions:

- What is the role of the epidemiology workforce during emergencies in low or limited resource settings?
- What are the capacity needs of the local and international epidemiology workforce during an emergency response in low resource settings?
- How can the emergency epidemiology workforce model be strengthened to transfer skills and knowledge among local and international responders?

Goal and objectives

This study will seek to define the epidemiological roles and required competencies of both the international and local epidemiology workforce during emergency response. This study is the first step in ensuring a more effective epidemiological response during future emergencies. Specifically, the objectives of this study are to:

- Describe existing models of deployment for epidemiologists in international emergency response, focusing on strengths and challenges.
- Identify the capacity needs of the epidemiology workforce in surveillance and response during an emergency.
- Provide evidence towards:
    - Creating a guide for the transfer of epidemiological knowledge and skills during emergency response.
    - Developing a framework for local and international epidemiology roles during emergencies.

METHOD and ANALYSIS

This mixed methods study uses an exploratory sequential study design, integrating qualitative and quantitative data sources from a scoping literature review, key informant interviews, an emergency responder survey, and semi-structured interviews.

Patient and public involvement

To develop the research questions we conducted a stakeholder consultation with international emergency response and global health agencies. Stakeholders will continue to support the study and results will be disseminated with and through them. No patients will be involved in this study.

Study population

The target population for key informant interviews are representatives from organisations that have a major emergency response deployment component, and the epidemiology workforce working through those organisations (both local and international). Organisations include WHO, the Global Outbreak Alert and Response Network (GOARN), MSF, and United States Centers for Disease Control and Prevention (US CDC).

The emergency responder survey and semi-structured interviews study population are the epidemiology emergency response workforce. We will specifically target Field Epidemiology Training Programme (FETP) officers and graduates, accessed through international epidemiology training networks such as TEPHINET (Training Programs in Epidemiology and Public Health Interventions Network).

Study design

We will conduct an exploratory sequential mixed methods study to build a comprehensive picture of the epidemiology workforce roles and required skills during emergency response. Mixed methods is the collection and integration of both quantitative and qualitative approaches to develop a more complete understanding of the research area.(32,33) This study will take advantage of the strengths and utility of each method based on the question being answered and the data to be collected.(33) The study is unequally weighted, with a qualitative emphasis.(32) Quantitative and qualitative components will be conducted sequentially.(32)

Consistent with the mixed methods approach, the integration and analysis of data from each activity will further inform the development of subsequent activities.(34) An iterative approach will ensure the design and direction of subsequent activities is appropriate according to the knowledge gained.

We will take a pragmatic interpretivist approach.(33,35,36) Understanding the information obtained will be a process of interpretation viewed through the researchers cultural and experience lens, and then explored with local and international stakeholders to further understand the meaning and potential application of the findings.(36) We acknowledge that the findings will be time and context bound and framed by the life experiences of the participants as well as that of the researchers.(36)

Study components

The study model in Figure 1 outlines the main study components and how they inform each other.

An overview of the current epidemiological emergency response workforce will be conducted through a scoping literature review. The integration of themes identified in the literature review and the initial stakeholder consultation will support development of a semi-structured interview guide for key informant interviews.

Findings from key informant interviews will inform the development of items for an online survey that will be disseminated via social media as well as distributed to officers and graduates of field epidemiology training programs, globally. Survey participants will be asked to participate in a semi-structured interview where convergent and divergent perspectives emerging from the survey will be further explored.

These activities will then inform the collection of evidence from epidemiology responders on the knowledge and skills required as first responders to a public health emergency. The study of epidemiology responders will consist of two activities; an online self-administered survey, and semi-structured interviews. The semi-structured interviews will provide an opportunity for further exploration of topics covered in the survey and examine the lived experience of the epidemiology workforce during an emergency.

Findings from the literature, key informant interviews, epidemiology responder survey, and semi-structured interviews will be integrated and shared back with stakeholders to support interpretation. These findings will form the basis for two key outputs; the emergency response epidemiology workforce framework and emergency response epidemiology workforce training guides. These tools will be developed in collaboration with stakeholders and then field tested.

Sampling

Early consultations with emergency response organisations identified the absence of accurate emergency response workforce databases. This means that it will not be possible to conduct representative sampling. Therefore, purposive sampling will be used to identify participants for the

various components in this study as the required participants will be contributing specific roles during emergencies.(37,38)

Key informant interviews

Key informant interviews will be people from organisations who have an epidemiology workforce active during public health emergencies. These organisations include WHO, MSF, GOARN, USCDC. Organisations will be asked to identify a short list of interviewees who fulfil the following criteria: epidemiology emergency response experience, and/or supervised epidemiologists during emergency response, and/or supported the deployment of epidemiologists, can communicate in English, and available for interview. These interviewees will then be asked to identify other people to interview (snowballing). To minimise clustering of networks, we will only select two candidates for interview per interviewee from the names listed during snowballing. We aim to interview at least 10 people and ensure there is a range of perspectives from different organisations by using minimum organisational quotas; WHO (n=4), GOARN (n=2), MSF (n=2), US CDC (n=2).

Epidemiology Responder Survey

Purposive sampling and snowballing will also be used for the epidemiology responder survey. Epidemiology responders will be invited to participate in the survey via field epidemiology networks including TEPHINET, the Australian Master of Applied Epidemiology (MAE) Alumni, European Programme for Intervention Epidemiology Training (EPIET) Alumni, and the United States Epidemic Intelligence Service (EIS) Alumni. A social media campaign will be run to recruit epidemiology emergency responders who are outside of these networks (Twitter, LinkedIn, and Facebook).

Sample size estimates will be calculated based on the TEPHINET alumni database (TEPHIconnect). TEPHIconnect have a population of 1700 active members; with a confidence level of 95% and confidence interval of 7, we hope to recruit at least 176 survey respondents. This sample size is

supported by previous unpublished survey response rates through TEPHIconnect (9.8%), MAE Alumni (49%), and EPIET (52%).

Semi-structured interviews

In the case of many survey participants self-selecting for interview, maximum variation sampling will be used. Selection of participants based on region, organisation, and/or event responded to, will ensure we have a cross-section of perspectives.(39) Interviews will continue until saturation is reached,(40,41) no more interviewees are identified, or the project period ends.

Data collection

Scoping literature review

Multiple bibliographic databases will be used to identify literature. Public health databases searched will be Scopus, PubMed, Web of Science, Embase, CINHAL, International Bibliography of the Social Sciences (IBSS) and the World Health Organisation library database (WHO LIS).

We will search 10 years of articles published in English; January 2009 to December 2018. A limited snowballing exercise will then be done, reference lists of all included studies will be searched. The same search strategy will be used in all databases. Date, time, and result number of each database search will be tracked in a Microsoft Excel spreadsheet.

Search terms will include, health personnel, health worker, epidemiologist, humanitarian, Public Health Professional, healthcare professional, health workforce, emergency, emergencies, disaster, relief work, disease outbreaks, hazard, relief operations, refugee, role, job, position, task.

Key Informant Interviews

Using an interview guide, the key informant interviews will be semi-structured and carried out by the same interviewer. Interviews will be conducted via telephone or internet communications. Questions aim to collect practical details on epidemiology deployment, common challenges experienced, as well as the interviewee's opinion on roles and required skills for field work,

performance management in the field, and workforce upskilling during emergency response. Questions will be informed by issues identified in the literature and stakeholder consultation. During the interview period, the questions will be reviewed in an iterative style to ensure flow of questions, to obtain clear answers.(42) Interviews will be recorded (with consent) and transcribed.

Epidemiology responder survey

The survey of epidemiology responders will be self-administered online via REDCap. The survey will be guided by the themes raised in the literature and during the key informant interviews. Questions will be reviewed by key informant interviewees, and field tested with epidemiologists who have emergency response experience. Open and closed ended questions will be used,(43) and will cover topics such as the number of previous emergency response deployments, technical support in the field, type of response, response context, cultural competency, role expectations compared to reality, and previous training and experience. Participants will be requested to complete the survey once only and it will be available in French and English.

Epidemiology responder semi-structured interviews

An interview guide will be used for each semi-structured interview. The semi-structured format will give interviewees scope to discuss what is important to them and the events they responded to. Interviews will be conducted in English, interviewees can request translation support if needed. The interview will delve deeper into the interviewee's experience during the emergency response. Interview questions will be informed by common themes identified in the survey and key informant interviews. Divergent survey findings will be further explored during the interviews. It is expected that interview questions may cover topics such as working with international and local epidemiologists, what their role was and how this connected with other components of the response, whether they participated in or conducted activities to upskill colleagues, and the perceived impact this had. They will be asked to discuss the challenges faced during the response and what they did to address them.

Data analysis

Sequential and concurrent analysis will be conducted;(32) data from each activity will be used to inform the next activity. We will analyse all activities as individual components, and then together in a mixed analysis.(34)

The literature review will be analysed thematically. Common themes and ideas identified will inform the development of key informant interviews. Key informant interviews will be analysed to support development of themes for the epidemiology responder survey, and then all previous findings will inform the question development for the semi-structured interviews.

Key informant interview and semi-structured interview data will be coded then analysed through thematic analysis, using NVivo 11. Thematic analysis will be an iterative process, with concepts and themes developed and combined as the findings are analysed and relationships are identified.(40,44,45) We define a theme as a pattern identified within the data.(44,46) These themes can be implicit or explicit. Analysis will be data-driven, inductive coding will be conducted initially to identify relationships within the data without using a pre-existing frame.(40,44) A thematic codebook outlining inclusion and exclusion criteria will be developed to ensure validity, consistency, and repeatability of coding. Interviews will be coded in two ways. Firstly, interviews will be coded based on the explicitly stated words and ideas (semantic), then interviews will be coded for underlying ideas and assumptions (latent).(44) All codes will be further reviewed, cleaned, analysed, summarised, and interpreted for meaning.(44)

Survey data will be analysed descriptively in STATA 15. Data will be further analysed to determine associations within and between respondents. Data will be examined for trends within and between international and local responders, comparison of trends between emergency response event types, and skill level and experience of responders.

Data interpretation

The data from these activities will be integrated and patterns, themes, and relationships formed and examined. The iterative approach will ensure that converging and diverging themes will be further explored in proceeding activities and support answering the research questions or development of further studies. We expect that mixing of the data will complement and extend the knowledge obtained.(47) Triangulation of this data will contribute evidence towards development of the workforce framework and identify training needs of local and international responders.(47)

Preliminary findings will be shared back with stakeholders, including key informant interviewees and study participants, to provide an opportunity to comment and provide further feedback.

DISCUSSION

Discourse around development and aid, including emergency response, identify that good intentions can cause unintentional harm.(48) Heymann et al identified the 'parachuting' in of international responders as a key ethical issue occurring during public health emergencies,(49) as is the lack of engaging and upskilling of local responders. In this study, response approaches will be studied to increase meaningful participation and engagement of local responders to ensure a contextually appropriate response.(20)

Maintaining a 'country focus' is one of WHO's guiding principles.(50) This study aims to ensure that local responders are an active part of defining the roles and required competencies of the epidemiology emergency response workforce. Both the local and international workforce included in the study will contribute towards developing new thinking about emergency response and ensuring the strengths of all responders are taken advantage of, as well as developing recommendations to ensure a legacy of an upskilled local workforce post-response. Capacity building, partnerships, active local participation, mentoring and coaching, and collaboration during emergency response are themes that will be explored.

The mixed methods iterative approach we will use in this study will support us to examine this topic in a flexible, semi-structured way, from a range of perspectives.(51) Emergency response is a complex area, in which a multitude of players are conducting a huge amount of work concurrently, under great pressure. Considering this complexity through a variety of lenses will improve our ability to understand the lived realities and experiences of epidemiology responders, in a multidimensional way.(51,52) The combination of survey data and semi-structured interviews will support the development of recommendations that use a broad range of evidence to address the current challenges.

Ethics

All activities have been approved by the Science and Medical Delegated Ethics Review Committee at the Australian National University, protocol numbers 2018/521, 2018/641, 2019/068.

Consent

Participation in this study will be voluntary; individual written (or online) consent will be sought from all participants. Each participant will receive a study information sheet that outlines the project and expectations in plain language.

Expected output

A key output of this research will be the development of evidence-based epidemiological emergency workforce recommendations to increase the effectiveness of epidemiologists during emergencies.

The research will contribute towards creating an epidemiology emergency workforce framework, which will underpin the role of the epidemiology workforce in a range of emergency types, as well as outline the required responder competencies.

The identification of unmet needs in the current epidemiology training, will support training programmes to address the identified needs and improve the application of skills during a response.

We will also identify, develop, and collate a range of evidence-based resources that can support appropriate upskilling during a response from entry level epidemiology onwards, for both local and international responders.

Dissemination

Through engaging both international and local emergency response partners throughout this study, we hope to ensure this research remains useful and relevant to potential end users.

All participants will be provided with a weblink to keep updated with study progress and outputs through the research. Results will also be disseminated through social media such as Twitter, LinkedIn, and Facebook. It is expected that manuscripts for publication as well as conference presentations will be developed to disseminate the results of this study. Manuscripts will be published in open access journals and findings will be further disseminated with and through participating emergency response organisations.

Limitations

As with all studies, this study has inherent limitations that we have attempted to mitigate. During this research we aim to minimise the impact that bias may have on the results we obtain. Interviews conducted in this research aim to understand processes and experiences, not to analyse how distributed these experiences are.(40) As a limited number of people have the knowledge and experience required to participate in the key informant interviews, purposive sampling may introduce bias. Organisational shortlisting of possible candidates could lead to selection of candidates who may have organisationally approved views on emergency response. Snowballing can also introduce bias as these interviewees are from the same network and therefore may hold similar opinions.(53) Pre-set selection criteria of possible participants and our multi-step sampling method aims to minimise these biases. As noted above, we aim to minimise clustering of common networks during snowballing through selection and invitation of a maximum of two candidates per interviewee.

Another possible limitation to this study is obtaining an accurate denominator for the target populations. The numbers and scale of emergencies change from year-to-year, and the workforce shifts according to need, as well as other factors such as organisational funding. We will attempt to mitigate this by working with local and international participating agencies and networks to ascertain epidemiology workforce estimations for the study period.

As the timing of the survey and interview is not during or immediately after an emergency response, recall bias may affect the information obtained. This timing may have added advantages as people have time to be reflective of what went well and what could be improved.(54,55)

There is a risk of selection bias during the epidemiology emergency responder survey as it is a self-administered online survey. To attempt to lessen the impact of this bias, we will use multiple pathways to recruit participants and we will collaborate closely with emergency response partners. As the survey will be available in multiple languages, this will increase representation from a variety of people as well as contexts.

There will also be varying timeframes between emergency response and survey completion between epidemiology responder survey participants. Participants may therefore have different levels of recall, and people with extremely negative or positive response experiences may remember differently. Questions on deployment will be broad to lessen the impact that this may have, and divergent findings will be further explored in the semi-structured interviews.

Additionally, the Principal Investigator (PI) for this study has worked in both acute and protracted emergencies as an epidemiologist. The views of the PI on this topic may introduce bias and influence the questions asked and the information obtained. The PI acknowledges this possible bias and will seek perspectives and interpretations on questions and analysis, with local and international stakeholders.

CONCLUSION

This study will build evidence to guide epidemiology emergency response and collaboration of the local and international epidemiology workforce that will enhance the effectiveness of the epidemiology response during future emergencies. Development of clearly articulated epidemiological roles during emergency response will enable organisations to better use the skills of the epidemiology workforce. The provision of recommendations to technically support local responders should decrease reliance on the international responder workforce and increase the cultural and contextual appropriateness of the response.

Author contributions: AP wrote the manuscript and is leading the study; TH, BO, DD, MK supported study design development and revised the manuscript critically. All authors read and approved the final manuscript.

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Data sharing statement: We are sharing this protocol with BMJ open readers to be open with our planned methods and outcomes. We will report future results of this study as de-identified aggregate data. Data analysis plans and data collection tools can be made available.

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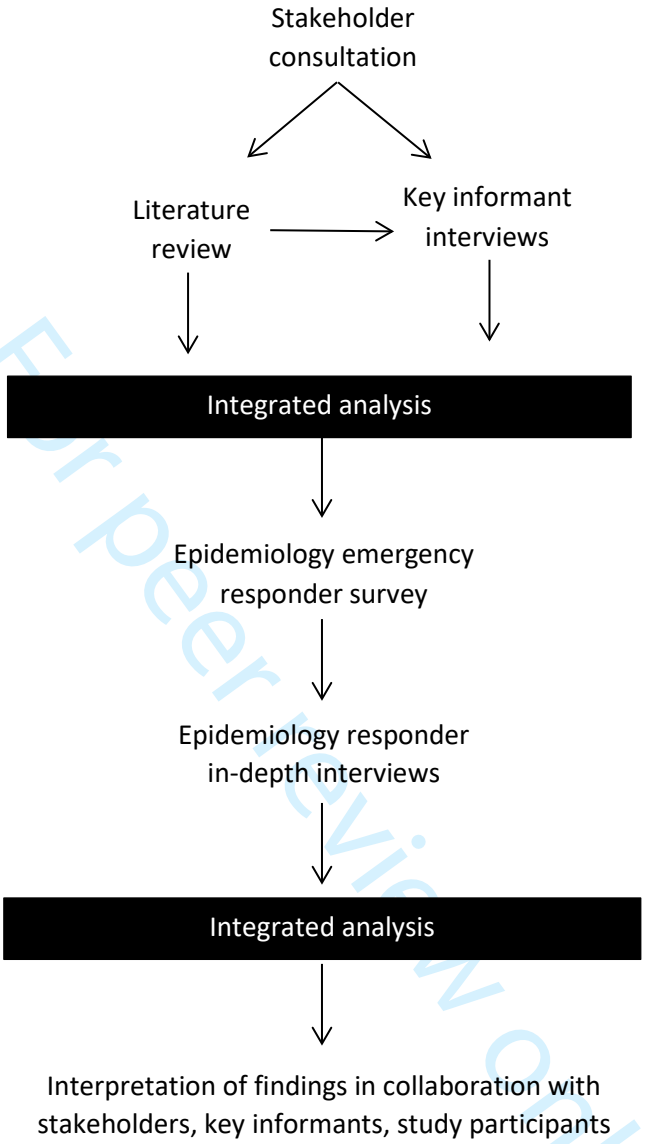
Figure 1: Study model for evidence building for emergency response epidemiology workforce



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Manuscript

Study protocol: Building an evidence base for epidemiology emergency response, a mixed methods study.

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List of abbreviations:
IHR - International Health Regulations
EPIET - European Programme Intervention Epidemiology Training
FETP - Field Epidemiology Training

FIFO - fly-in-fly-out
GOARN - Global outbreak alert and response network
IHR – International Health Regulations
MAE - Master of Applied Epidemiology
MSF - Médecins Sans Frontières
PI - Principal Investigator
TEPHINET - Training Programs in Epidemiology and Public Health Interventions Network
US CDC - United States Centers for Disease Control and Prevention
WHO - World Health Organization

Abstract

Introduction: Determinants and drivers for emergencies such as political instability, weak health systems, climate change, and forcibly displaced populations, are increasing the severity, complexity and frequency of public health emergencies. As emergencies become more complex, it is increasingly important that the required skillset of the emergency response workforce is clearly defined. To enable essential epidemiological activities to be implemented and managed during an emergency, a workforce is required with the right mix of skills, knowledge, experience, and local context awareness. This study aims to provide local and international responders with an opportunity to actively contribute to the development of new thinking around emergency response roles and required competencies. In this study, we will develop recommendations using a broad range of evidence to address identified lessons and challenges so that future major emergency responses are culturally and contextually appropriate, and less reliant on long-term international deployments.

Method and analysis: We will conduct a mixed methods study using an exploratory sequential study design. The integration of four data sources, including key informant interviews, a scoping literature review, survey, and semi-structured interviews will allow the research questions to be examined in a flexible, semi-structured way, from a range of perspectives. The study is unequally weighted, with a qualitative emphasis. We will analyse all activities as individual components, and then together in an integrated analysis. Thematic analysis will be conducted in NVivo11 and quantitative analysis will be conducted in Stata15.

Ethics and dissemination: All activities have been approved by the Science and Medical Delegated Ethics Review Committee at the Australian National University (protocol numbers 2018-521, 2018-641, 2019-068). Findings will be disseminated through international and local deployment partners, peer reviewed publication, presentation at international conferences and through social media such as Twitter and Facebook.

ARTICLE SUMMARY

Strengths and limitations of this study

1. The evidence in this area remains weak with few scientific studies; preliminary stakeholder consultation supported the need for more evidence to inform best practice.
2. This study will build evidence to guide deployment and collaboration of the local and international epidemiology workforce that will enhance the effectiveness of the epidemiology response during future emergencies.
3. The iterative approach will support the research to explore both convergent and divergent findings in greater depth.
4. We expect a diversity of respondents with a range of perspectives which will improve our ability to understand lived realities and experiences in a multidimensional way.
5. We anticipate the sample will be multinational, we acknowledge this as both a strength and limitation, translation will be offered where needed.

Box 1: Terms used in this study

Epidemiological role: a person who participates in surveillance, response, and disease investigation and control activities during an emergency.
Epidemiology responder: a person working in an epidemiological role during an emergency response, they may or may not be a citizen of the country they are responding within.
Local responder: A responder who is a citizen of the country in which the response is occurring.
International responder: A responder who is not a citizen of the country in which the response is occurring.

INTRODUCTION

Emergencies do not discriminate; they can happen at any time, in any country. Whether they are a natural hazard such as a flood or cyclone, an infectious disease outbreak, or domestic or regional instability, any serious disruption of community functioning may lead to a situation where the ability

of the affected community to manage using its own resources is exceeded.(1) The International Health Regulations (IHR) are a legal instrument that defines the rights and obligations of countries regarding infectious disease surveillance, alert, and response.(2) Countries signatory to the IHR, regularly evaluate their capacity as outlined in the IHR;(2) IHR evaluations have identified that few countries have met the minimum standard.(3,4) One core IHR capacity is related to workforce, the routine evaluations have identified that there is still much work to be done to achieve resilient health systems with a strong local workforce capable of responding to public health emergencies.(5)

Emergency response requires collaboration between many professions; epidemiologists are generally recognised as a core contributor. The primary role of the epidemiology emergency response workforce is to ensure the health and safety of the affected population through the minimization of mortality and morbidity.(6,7) This is achieved through a number of activities including establishing and/or monitoring early warning surveillance systems, using multiple sources of data and information to conduct risk assessments, rapidly, efficiently and effectively initiating investigation and control activities, and providing information for decision-making.(6–8)

This study will seek to define the epidemiological roles and required competencies of both the international and local epidemiology workforce during emergency response.

Study rationale

Internationally, the determinants and drivers for emergencies such as political instability,(8) weak health systems, (5,9) climate change, (10,11) and forcibly displaced populations,(12) are increasing in severity and frequency.(4) Emergencies are becoming protracted and more complex;(4,8,13–16) this has implications for emergency response management and the required emergency response workforce. To enable essential epidemiological activities to be implemented and effectively managed during an emergency, a workforce is required with the right mix of skills, knowledge, experience, and local context awareness.

When emergencies exceed local workforce capacity, support may be required in the form of the international emergency response workforce.(3) Gostin and Friedman in their 2015 review of the West African Ebola response identified that there was a need to refine who is deployed and to certify the competencies of the public health emergency response workforce.(9) Although the international workforce are used to fill technical needs, many factors affect their usefulness. Responders without the necessary leadership, technical, cultural, or communication skills can limit the effectiveness of the response, drain limited resources, and potentially cause harm.(17,18) The short-term fly-in fly-out (FIFO) nature of international emergency responders means high and rapid staff turnover, which can lead to issues with continuity of response,(19) institutional knowledge loss,(19) and inconsistent support for local responders.

Examining the international epidemiology workforce role is only one part of the picture. Local epidemiology workforce knowledge and context understanding is essential to ensuring the effectiveness of emergency response.(20,21) Previous healthcare professional research has identified the lack of engagement and training of local responders during emergency response as problematic.(17) Supporting the local workforce throughout an emergency can contribute towards local workforce upskilling, continuity of essential work, and reduce the impact of international staffing rotations.(19) Vignettes found in the literature support the value of capacity building of the local workforce during an emergency,(20,22–26) however the evidence for best practice remains weak due to few scientific studies particularly focused on this area.

Checchi et al highlighted the absence of formal professional certification for professionals during emergencies.(27) Work has been started for certification of medical personnel during emergencies,(27,28) however, this has not yet been initiated for other public health professions. Emergency response organisations, such as the World Health Organization (WHO) and Médecins Sans Frontières (MSF), aspire to similar values of technical excellence and professionalism.(29–31) This study will build evidence on what technical excellence and professionalism looks like for the epidemiology

0workforce during emergencies. Clarity on roles and competencies required during international emergency response will support adequate preparation prior to deployment of international responders.(17,18) New thinking is needed to identify how local and international responder (Box 1) collaboration and upskilling can strengthen the effectiveness of an emergency response. Development of this knowledge will increase the cultural and contextually appropriate nature of response as well as facilitate less long-term reliance on the international workforce.(20)

Study questions

We conducted a stakeholder consultation in 2018 with five international emergency response and global health agencies. This consultation aimed to identify needs in emergency response research and needs according to these emergency response agencies. The findings of this consultation, combined with the reviewed literature, framed the development of our research questions.

We aim to answer three questions:

- What is the role of the epidemiology workforce during emergencies in low or limited resource settings?
- What are the capacity needs of the local and international epidemiology workforce during an emergency response in low resource settings?
- How can the emergency epidemiology workforce model be strengthened to transfer skills and knowledge among local and international responders?

Goal and objectives

This study will seek to define the epidemiological roles and required competencies of both the international and local epidemiology workforce during emergency response. This study is the first step in ensuring a more effective epidemiological response during future emergencies. Specifically, the objectives of this study are to:

- Describe existing models of deployment for epidemiologists in international emergency response, focusing on strengths and challenges.
- Identify the capacity needs of the epidemiology workforce in surveillance and response during an emergency.
- Provide evidence towards:
    - Creating a guide for the transfer of epidemiological knowledge and skills during emergency response.
    - Developing a framework for local and international epidemiology roles during emergencies.

METHOD and ANALYSIS

This mixed methods study uses an exploratory sequential study design, integrating qualitative and quantitative data sources from a scoping literature review, key informant interviews, an emergency responder survey, and semi-structured interviews.

Patient and public involvement

To develop the research questions we conducted a stakeholder consultation with international emergency response and global health agencies. Stakeholders will continue to support the study and results will be disseminated with and through them. No patients will be involved in this study.

Study population

The target population for key informant interviews are representatives from organisations that have a major emergency response deployment component, and the epidemiology workforce working through those organisations (both local and international). Organisations include WHO, the Global Outbreak Alert and Response Network (GOARN), MSF, and United States Centers for Disease Control and Prevention (US CDC).

The emergency responder survey and semi-structured interviews study population are the epidemiology emergency response workforce. We will specifically target Field Epidemiology Training Programme (FETP) officers and graduates, accessed through international epidemiology training networks such as TEPHINET (Training Programs in Epidemiology and Public Health Interventions Network).

Study design

We will conduct an exploratory sequential mixed methods study to build a comprehensive picture of the epidemiology workforce roles and required skills during emergency response. Mixed methods is the collection and integration of both quantitative and qualitative approaches to develop a more complete understanding of the research area.(32,33) This study will take advantage of the strengths and utility of each method based on the question being answered and the data to be collected.(33) The study is unequally weighted, with a qualitative emphasis.(32) Quantitative and qualitative components will be conducted sequentially.(32)

Consistent with the mixed methods approach, the integration and analysis of data from each activity will further inform the development of subsequent activities.(34) An iterative approach will ensure the design and direction of subsequent activities is appropriate according to the knowledge gained.

We will take a pragmatic interpretivist approach.(33,35,36) Understanding the information obtained will be a process of interpretation viewed through the researchers cultural and experience lens, and then explored with local and international stakeholders to further understand the meaning and potential application of the findings.(36) We acknowledge that the findings will be time and context bound and framed by the life experiences of the participants as well as that of the researchers.(36)

Study components

The study model in Figure 1 outlines the main study components and how they inform each other.

An overview of the current epidemiological emergency response workforce will be conducted through a scoping literature review. The integration of themes identified in the literature review and the initial stakeholder consultation will support development of a semi-structured interview guide for key informant interviews.

Findings from key informant interviews will inform the development of items for an online survey that will be disseminated via social media as well as distributed to officers and graduates of field epidemiology training programs, globally. Survey participants will be asked to participate in a semi-structured interview where convergent and divergent perspectives emerging from the survey will be further explored.

These activities will then inform the collection of evidence from epidemiology responders (Box 1) on the knowledge and skills required as first responders to a public health emergency. The study of epidemiology responders will consist of two activities; an online self-administered survey, and semi-structured interviews. The semi-structured interviews will provide an opportunity for further exploration of topics covered in the survey and examine the lived experience of the epidemiology workforce during an emergency.

Findings from the literature, key informant interviews, epidemiology responder survey, and semi-structured interviews will be integrated and shared back with stakeholders to support interpretation. These findings will form the basis for two key outputs; the emergency response epidemiology workforce framework and emergency response epidemiology workforce training guides. These tools will be developed in collaboration with stakeholders and then field tested.

Sampling

Early consultations with emergency response organisations identified the absence of accurate emergency response workforce databases. This means that it will not be possible to conduct representative sampling. Therefore, purposive sampling will be used to identify participants for the

various components in this study as the required participants will be contributing specific roles during emergencies.(37,38) Participants will not be directly compensated for participation.

Key informant interviews

Key informant interviews will be people from organisations who have an epidemiology workforce active during public health emergencies. These organisations include WHO, MSF, GOARN, USCDC. Organisations will be asked to identify a short list of interviewees who fulfil the following criteria: epidemiology emergency response experience, and/or supervised epidemiologists during emergency response, and/or supported the deployment of epidemiologists, can communicate in English, and available for interview. These interviewees will then be asked to identify other people to interview (snowballing). To minimise clustering of networks, we will only select two candidates for interview per interviewee from the names listed during snowballing. We aim to interview at least 10 people and ensure there is a range of perspectives from different organisations by using minimum organisational quotas based on organizational emergency epidemiology response size; WHO (n=4), GOARN (n=2), MSF (n=2), US CDC (n=2).

Epidemiology Responder Survey

Access to organizational lists of emergency responders was not approved by participating organizations, therefore we were unable to construct a sampling frame. For this reason purposive sampling and snowballing was selected to identify participants for the epidemiology responder survey. Epidemiology responders will be invited to participate in the survey via field epidemiology networks including TEPHINET, the Australian Master of Applied Epidemiology (MAE) Alumni, European Programme for Intervention Epidemiology Training (EPIET) Alumni, and the United States Epidemic Intelligence Service (EIS) Alumni. A social media campaign will be run to recruit epidemiology emergency responders who are outside of these networks (Twitter, LinkedIn, and Facebook) so as to disseminate the survey as widely as possible across all regions of the world

Sample size estimates will be calculated based on the TEPHINET alumni database (TEPHIconnect). TEPHIconnect have a population of 1700 active members; with a confidence level of 95% and confidence interval of 7, we hope to recruit at least 176 survey respondents. This sample size is supported by previous unpublished survey response rates through TEPHIconnect (9.8%), MAE Alumni (49%), and EPIET (52%).

Semi-structured interviews

In the case of many survey participants self-selecting for interview, maximum variation sampling will be used. Selection of participants based on region, organisation, and/or event responded to, will ensure we have a cross-section of perspectives.(39) Interviews will continue until saturation is reached,(40,41) no more interviewees are identified, or the project period ends. We anticipate to interview a minimum of 20 people.(41–43)

Data collection

Scoping literature review

Multiple bibliographic databases will be used to identify literature. Public health databases searched will be Scopus, PubMed, Web of Science, Embase, CINHAL, International Bibliography of the Social Sciences (IBSS) and the World Health Organisation library database (WHO LIS).

We will search 10 years of articles published in English; January 2009 to December 2018. A limited snowballing exercise will then be done, reference lists of all included studies will be searched. The same search strategy will be used in all databases. Date, time, and result number of each database search will be tracked in a Microsoft Excel spreadsheet.

Search terms will include, health personnel, health worker, epidemiologist, humanitarian, Public Health Professional, healthcare professional, health workforce, emergency, emergencies, disaster, relief work, disease outbreaks, hazard, relief operations, refugee, role, job, position, task.

Key Informant Interviews

Using an interview guide, the key informant interviews will be semi-structured and carried out by the same interviewer. Interviews will be conducted via telephone or internet communications. Questions aim to collect practical details on epidemiology deployment, common challenges experienced, as well as the interviewee's opinion on roles and required skills for field work, performance management in the field, and workforce upskilling during emergency response. Questions will be informed by issues identified in the literature and stakeholder consultation. During the interview period, the questions will be reviewed in an iterative style to ensure flow of questions, to obtain clear answers.(44) Interviews will be recorded (with consent) and transcribed.

Epidemiology responder survey

The survey of epidemiology responders will be self-administered online via REDCap. The survey will be guided by the themes raised in the literature and during the key informant interviews. Questions will be reviewed by key informant interviewees, and field tested with epidemiologists who have emergency response experience. Open and closed ended questions will be used,(45) and will cover topics such as the number of previous emergency response deployments, technical support in the field, type of response, response context, cultural competency, role expectations compared to reality, and previous training and experience. Participants will be requested to complete the survey once only and it will be available in French and English.

Epidemiology responder semi-structured interviews

An interview guide will be used for each semi-structured interview. The same interviewer will conduct all interviews. The semi-structured format will give interviewees scope to discuss what is important to them and the events they responded to. Interviews will be conducted in English, interviewees can request translation support if needed. The interview will delve deeper into the interviewee's experience during the emergency response. Interview questions will be informed by common themes identified in the survey and key informant interviews. Divergent survey findings will be further explored during the interviews. It is expected that interview questions may cover topics

such as working with international and local epidemiologists, what their role was and how this connected with other components of the response, whether they participated in or conducted activities to upskill colleagues, and the perceived impact this had. They will be asked to discuss the challenges faced during the response and what they did to address them.

Data analysis

Sequential and concurrent analysis will be conducted;(32) data from each activity will be used to inform the next activity. We will analyse all activities as individual components, and then together in a mixed analysis.(34)

The literature review will be analysed thematically. Common themes and ideas identified will inform the development of key informant interviews. Key informant interviews will be analysed to support development of themes for the epidemiology responder survey, and then all previous findings will inform the question development for the semi-structured interviews.

Key informant interview and semi-structured interview data will be coded by two people. A code book will be used with clear definitions for each code. Discrepancies will be discussed between coders and clarified in the code book if necessary.(46) The coding will then analysed through thematic analysis, using NVivo 11. Thematic analysis will be an iterative process, with concepts and themes developed and combined as the findings are analysed and relationships are identified.(40,47,48) We define a theme as a pattern identified within the data.(47,49) These themes can be implicit or explicit. Analysis will be data-driven, inductive coding will be conducted initially to identify relationships within the data without using a pre-existing frame.(40,47) A thematic codebook outlining inclusion and exclusion criteria will be developed to ensure validity, consistency, and repeatability of coding. Interviews will be coded in two ways. Firstly, interviews will be coded based on the explicitly stated words and ideas (semantic), then interviews will be coded for underlying ideas and assumptions (latent).(47) All codes will be further reviewed, cleaned, analysed, summarised, and interpreted for meaning.(47)

Survey data will be analysed descriptively in STATA 15. Data will be further analysed to determine associations within and between respondents. Data will be examined for trends within and between international and local responders, comparison of trends between emergency response event types, and skill level and experience of responders.

Triangulation and a mixed methods matrix will be used to combine qualitative and quantitative themes.(50) This will be conducted iteratively throughout the research, as outlined in the study model (Figure 1). **Data interpretation**

The data from all of these activities will be integrated and patterns, themes, and relationships formed and examined. The iterative approach will ensure that converging and diverging themes will be further explored in proceeding activities and support answering the research questions or development of further studies. We expect that mixing of the data will complement and extend the knowledge obtained.(51) Triangulation of this data will contribute evidence towards development of the workforce framework and identify training needs of local and international responders.(51)

Preliminary findings will be shared back with stakeholders, including key informant interviewees and study participants, to provide an opportunity to comment and provide further feedback. Workshops will be conducted with stakeholders to ensure the results are interpreted according to local settings. The theory of change model will be used to support the process of taking the themes identified in the research through to stakeholder consultation and then framework development and implementation.(52,53)

DISCUSSION

Discourse around development and aid, including emergency response, identify that good intentions can cause unintentional harm.(54) Heymann et al identified the 'parachuting' in of international responders as a key ethical issue occurring during public health emergencies,(55) as is the lack of engaging and upskilling of local responders. In this study, response approaches will be studied to

increase meaningful participation and engagement of local responders to ensure a contextually appropriate response.(20)

Maintaining a 'country focus' is one of WHO's guiding principles.(56) This study aims to ensure that local responders are an active part of defining the roles and required competencies of the epidemiology emergency response workforce. Both the local and international workforce included in the study will contribute towards developing new thinking about emergency response and ensuring the strengths of all responders are taken advantage of, as well as developing recommendations to ensure a legacy of an upskilled local workforce post-response. Capacity building, partnerships, active local participation, mentoring and coaching, and collaboration during emergency response are themes that will be explored.

The mixed methods iterative approach we will use in this study will support us to examine this topic in a flexible, semi-structured way, from a range of perspectives.(57) Emergency response is a complex area, in which a multitude of players are conducting a huge amount of work concurrently, under great pressure. Considering this complexity through a variety of lenses will improve our ability to understand the lived realities and experiences of epidemiology responders, in a multidimensional way.(57,58) The combination of survey data and semi-structured interviews will support the development of recommendations that use a broad range of evidence to address the current challenges.

Ethics

All activities have been approved by the Science and Medical Delegated Ethics Review Committee at the Australian National University, protocol numbers 2018-521, 2018-641, 2019-068.

Consent

Participation in this study will be voluntary; individual written (or online) consent will be sought from all participants. Each participant will receive a study information sheet that outlines the project and expectations in plain language.

Expected output

A key output of this research will be the development of evidence-based epidemiological emergency workforce recommendations to increase the effectiveness of epidemiologists during emergencies.

The research will contribute towards creating an epidemiology emergency workforce framework, which will underpin the role of the epidemiology workforce in a range of emergency types, as well as outline the required responder competencies.

The identification of unmet needs in the current epidemiology training, will support training programmes to address the identified needs and improve the application of skills during a response.

We will also identify, develop, and collate a range of evidence-based resources that can support appropriate upskilling during a response from entry level epidemiology onwards, for both local and international responders.

Dissemination

Through engaging both international and local emergency response partners throughout this study, we hope to ensure this research remains useful and relevant to potential end users.

All participants will be provided with a weblink to keep updated with study progress and outputs through the research. Results will also be disseminated through social media such as Twitter, LinkedIn, and Facebook. It is expected that manuscripts for publication as well as conference presentations will be developed to disseminate the results of this study. Manuscripts will be published in open access journals and findings will be further disseminated with and through participating emergency response organisations.

Limitations

As with all studies, this study has inherent limitations that we have attempted to mitigate. During this research we aim to minimise the impact that bias may have on the results we obtain. Interviews

conducted in this research aim to understand processes and experiences, not to analyse how distributed these experiences are.(40) As a limited number of people have the knowledge and experience required to participate in the key informant interviews, purposive sampling may introduce bias. Organisational shortlisting of possible candidates could lead to selection of candidates who may have organisationally approved views on emergency response. Snowballing can also introduce bias as these interviewees are from the same network and therefore may hold similar opinions.(59) Pre-set selection criteria of possible participants and our multi-step sampling method aims to minimise these biases. As noted above, we aim to minimise clustering of common networks during snowballing through selection and invitation of a maximum of two candidates per interviewee.

Another possible limitation to this study is obtaining an accurate denominator for the target populations. The numbers and scale of emergencies change from year-to-year, and the workforce shifts according to need, as well as other factors such as organisational funding. We will attempt to mitigate this by working with local and international participating agencies and networks to ascertain epidemiology workforce estimations for the study period.

As the timing of the survey and interview is not during or immediately after an emergency response, recall bias may affect the information obtained. This timing may have added advantages as people have time to be reflective of what went well and what could be improved.(60,61)

There is a risk of selection bias during the epidemiology emergency responder survey as it is a self-administered online survey. To attempt to lessen the impact of this bias, we will use multiple pathways to recruit participants and we will collaborate closely with emergency response partners. As the survey will be available in multiple languages, this will increase representation from a variety of people as well as contexts.

There will also be varying timeframes between emergency response and survey completion between epidemiology responder survey participants. Participants may therefore have different levels of

recall, and people with extremely negative or positive response experiences may remember differently. Questions on deployment will be broad to lessen the impact that this may have, and divergent findings will be further explored in the semi-structured interviews.

Additionally, the Principal Investigator (PI) for this study has worked in both acute and protracted emergencies as an epidemiologist. The views of the PI on this topic may introduce bias and influence the questions asked and the information obtained. The PI acknowledges this possible bias and will seek perspectives and interpretations on questions and analysis, with local and international stakeholders.

This study will build evidence to guide epidemiology emergency response and collaboration of the local and international epidemiology workforce that will enhance the effectiveness of the epidemiology response during future emergencies. Development of clearly articulated epidemiological roles during emergency response will enable organisations to better use the skills of the epidemiology workforce. The provision of recommendations to technically support local responders should decrease reliance on the international responder workforce and increase the cultural and contextual appropriateness of the response.

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Data sharing statement: We are sharing this protocol with BMJ open readers to be open with our planned methods and outcomes. We will report future results of this study as de-identified aggregate data. Data analysis plans and data collection tools can be made available.

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Figure 1: Study model for evidence building for emergency response epidemiology workforce