Chapter 4.13: Addressing complexity through mixed methods

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Learning objectives

To understand key factors to consider when developing a mixed methods study for research in Health EDRM, including:

- Basic principles of mixed methods research.
- Relevance of mixed methods design for disaster research.
- Systems thinking for use in disaster research.
- Basic tenets of complexity theory and their relevance for disaster research.

Introduction

Different types of disaster have different

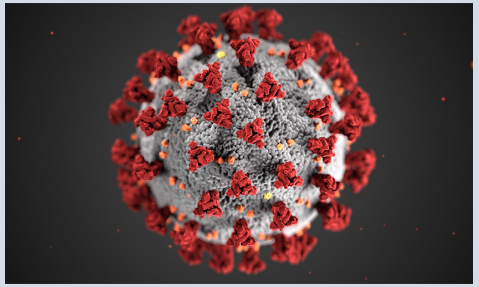
- Timing
- Characteristics
- Non-linear impacts

These contribute to the complexity of prevention, preparedness, response and recovery, and pose challenges for designing research relevant to disaster health and Health EDRM.

Introduction

Warning systems make it possible to anticipate some weather-related events, but not:

- Wildfires
- Tornadoes
- Pandemics



For disaster health research, it is rare to see a simple, single research design that can capture the complexity needed for disaster studies.

Mixed methods and a systems approach provide options to address some of these issues.

Introduction to mixed methods research

- Mixed methods research is recognised as a third methodology, with its own set of assumptions and criteria for quality.
- It has its own set of characteristics.
- It combines **qualitative** and **quantitative** methods.
- It is often used when quantitative or qualitative methods are not sufficient on their own.

Introduction

"Mixed methods research is the type of research in which a researcher or team of researchers combines elements of qualitative and quantitative research approaches (such as the use of qualitative and quantitative viewpoints, data collection, analysis, inference techniques) for the broad purposes of breadth and depth of understanding and corroboration." (Johnson *et al*)

Critiques of mixed methods research

- Mixed methods research is sometimes regarded as superior to qualitative and quantitative methodologies but has limited methods (e.g., surveys and interviews)
- There is a challenge in defining what is meant by mixed methods research.
- It can be diffiucult to manage conflicting assumptions, paradigms and values.

Mixed Methods Research Designs

- When deciding whether or not to use a mixed methods research design, the first step is to consider the research question, which should drive the methodological approach.
- When the research question is clear, the most feasible and appropriate methodologies can be identified.
- It is essential to be aware of theoretical and epistemological differences between the qualitative and quantitative methods being considered.

Mixed Methods Research Designs

Simple research questions:

- have one concept or variable of interest
- need one type of data to answer it

Complex research questions:

- Require more complex methods
- Have multiple concepts or groups, and changing trajectories
- More than one type of data needed to answer question

Mixed Methods Research Designs

Developing the design:

- Decide whether the main method is quantitative or qualitative
- Decide how the supplementary method will support the main method

- "QUAN" or "QUAL" might be used to indicate the main method.
- "quan" or "qual" might be used to indicate the other method.
- Symbols such as "->" or "+" might be used to indicate whether the methods will be implemented sequentially or at the same time.

Overview of mixed methods designs and applications to Health EDRM research

Design	Structural description	Applied example	Data collection and analysis
QUAN + QUAL	Quantitative and qualitative methods are implemented simultaneously and have the same weighting	Randomized trial measuring behavioural outcomes following a disaster preparedness campaign using a community survey and telephone interviews with a subset of the survey sample	QUAN: Analysis of numerical survey responses on a Likert scale QUAL: Thematic analysis of interview data
QUAL + quan	Main method is qualitative, implemented simultaneously with quantitative method which is weighted less	Focus groups with citizens who have experienced flooding of their homes, supplemented with a short survey related to accessing mental health services	QUAL: Iterative content analysis of focus group data quan: Analysis of binary responses (for example, yes and no).
QUAN + qual	Main method is quantitative, implemented simultaneously with qualitative method which is weighted less	Exit survey with citizens attending influenza vaccination clinics, supplemented with field observations of crowd control and dynamics of the flow of service delivery	QUAN: Analysis of Likert scale ratings from survey qual: thematic analysis from 2 observers field notes

Overview of mixed methods designs and applications to Health EDRM research

quan → QUAL	Supplemental method is quantitative, implemented before the main qualitative method	Questionnaire sent to participants before a table top exercise to identify priority topics for discussion, followed by field observations and thematic analysis of the discussions during the exercise and debriefing sessions	quan: Analysis of ranking of topics. QUAL: Thematic analysis and triangulation of field notes taken by observers with transcripts of discussions.
qual → QUAN	Supplemental method is qualitative, implemented before the main quantitative method	Key informant interviews to pilot test items for a health risk perception survey being administered to first responders following a prolonged response to wildfires	Interview data analysed deductively according to a coding grid based on topics from the risk perception survey
QUAL → QUAN	Quantitative and qualitative methods are weighted equally, but the qualitative method is implemented first	Community consultation focus groups followed by a community survey to set priorities for a public health action plan	Inductive thematic analysis of focus group data to identify priorities, followed by ranking of priorities

Overview of mixed methods designs and applications to Health EDRM research

Design	Structural description	Applied example	Data collection and analysis
QUAN → QUAL	Quantitative and qualitative methods are weighted equally, but the quantitative method is implemented first	Rapid needs assessment survey distributed to households impacted by a chemical spill, followed by focus groups with a subset of the population who are at heightened risk	Standardized post-disaster survey analysed to identify neighbourhoods disproportionately impacted using GIS mapping; subsequent outreach and exploratory data collection and analysis to understand short-term health impacts

Considerations for design and implementation

When combining qualitative and quantitative methods:

- Consider how the different paradigms will be reconciled
- Be certain of the rationale for using mixed methods research to answer the research question

Research design is often methods-centric:

- Focus on combining specific methods at different timepoints
- Typical decisions include determining whether the data will be collected and analysed at the same time, or separately and integrated later.

Considerations for design and implementation

Mixed methods research is often described as the obvious choice, but need to consider:

- Are two methods better than one?
- Are mixed methods research projects more comprehensive?
- Will the mixed methods study use limited qualitative methods and not explore the range of qualitative methods?
- Might this limit creativity in addressing complex issues in a health and disaster context?

Considerations for design and implementation

Important to consider how theory and epistemological differences will be managed in mixed methods research.

Paradigms are guides for researchers to determine how to approach a research topic, including:

- Research question
- Design
- Methods
- Analyses

A pragmatic paradigm is the most widely used in mixed methods research and when using multiple methods, the task is simpler because the paradigms are acknowledged for each method and presented separately.

Considerations for design and implementation

The **function** of the mixed method study will determine how the qualitative and quantitative methods are combined at the interface point.

When determining a function, it is important to:

- Consider whether the methods need to be combined to answer the same research question; or
- Whether a series of research questions related to the topic require mixed method design

Considerations for design and implementation

- The **findings** of mixed methods research can be integrated in different ways and at different times.
- Use of mixed method matrix is an option for identifying patterns in the different datasets.
- Publications of triangulation protocols are important contributions to the literature, by helping readers to understand at what points the datasets were integrated and what steps were followed

Considerations for design and implementation

- In the early stages of designed randomized trials, qualitative approaches can be used to establish the fit of a conceptual framework or theory for the intervention.
- They can also be used to gather information about the context in which the intervention will be implemented and engage stakeholders.
- For complex interventions, mixed methods research can be used to evaluate outcomes and implementation

Considerations for design and implementation

- Qualitative methods are often used in constructing or piloting surveys or other data collection instruments.
- They are also frequently used to add depth to quantitative designs.
- As an intervention is rolled out, qualitative methods can be used to assess the fidelity of the implementation to determine the extent to which the protocol is being followed as intended.
- Context is important for understanding mechanisms of why an intervention works.
- Qualitative approaches provide options for generating process-related data.

Case Study: *Perceptions of earthquake survivors in Amatrice, Italy*

- Series of devastating earthquakes in 2015-16, with 238 deaths in Amatrice.
- Massazza et al. conducted a mixed methods research study with earthquake survivors., and published the results in 2019
- Explored how survivors perceived the damage from the earthquake and how those perceptions aligned with the concept of natural versus human-made disasters.

Case Study: *Perceptions of earthquake survivors in Amatrice, Italy*

- Study used a mixed methods, longitudinal design, with quantitative surveys and interviews conducted at two time points (16 months apart)
- Initial: received 127 responses and 52 survey respondents participated in one-on-one interviews
- Follow up survey: completed by 112 of the original respondents
- Researchers triangulated findings from quantitative data with narrative data from qualitative interviews..
- Qualitative data corroborated and expanded analyses for in-depth understanding of complexity of perceptions and understandings of natural vs human-made disasters

Case Study: *Perceptions of earthquake survivors in Amatrice, Italy*

Excellent example of how mixed methods can be presented together.

Summary of quantitative results in text, tables and graphs, followed by a detailed explanation of emergent themes from qualitative data.

Discussion includes:

- Points of convergence
- Points of divergence
- How in-depth thematic analysis expanded understanding of quantitative results

Systems thinking and complexity

- Most disasters are complex and require collaboration across different sectors, organizations and jurisdictional boundaries.
- Type of disaster determines which organizations and jurisdictions must be involved in planning for Health EDRM, including prevention, preparedness response and recovery.
- Useful to look at disaster health research questions through a systems lens and to acknowledge complexity in research project design – particularly interventions.

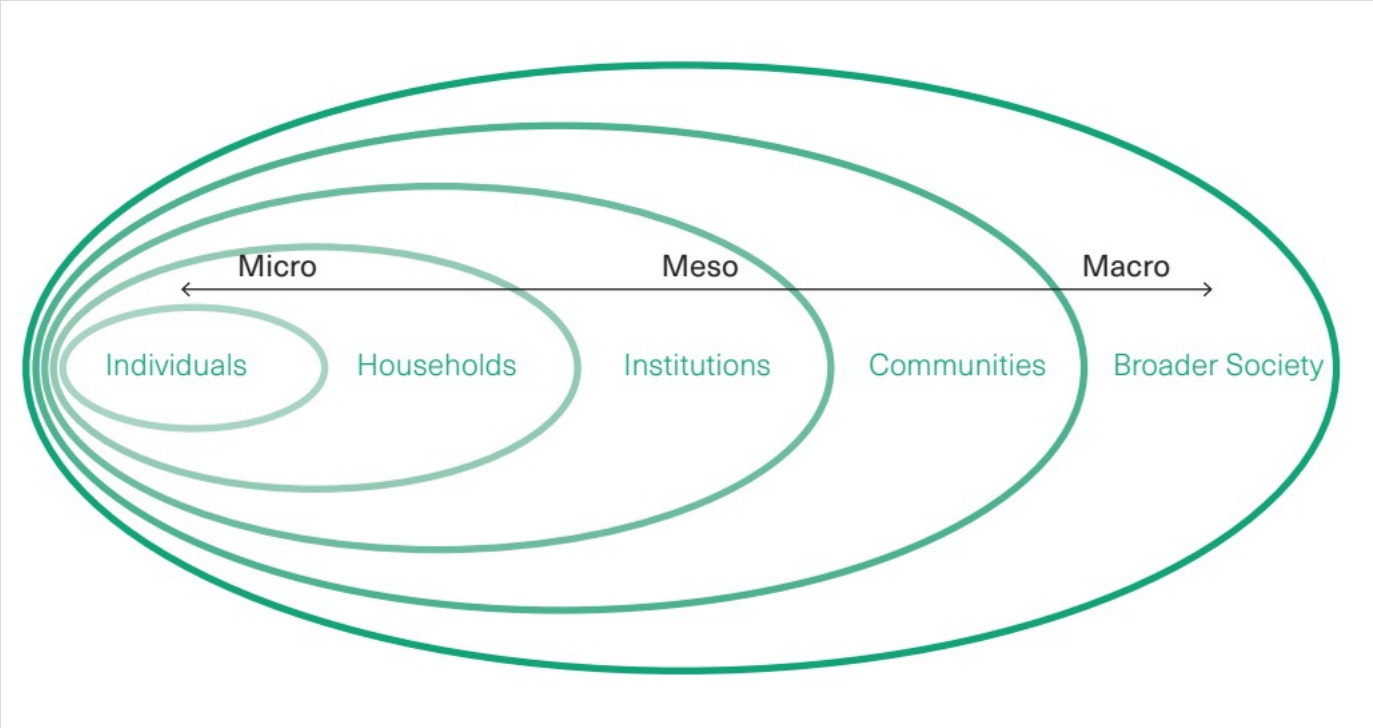
Systems thinking and complexity

- Systems made up of different interdependent components and actors/stakeholders.
- Can be complex depending on how tightly-coupled the interdependencies are.
- Has gained recognition in various fields and can be used to understand context, mechanisms and outcomes.
- Way of examining how things are connected within a whole and how parts within the whole interact.

Systems thinking and complexity

- Defined as "a set of 'synergistic analytic skills' used to help describe a complex set of interacting factors that produce outcomes, to predict their behaviour and to formulate interventions to achieve desired (and avoid pernicious) results".
- Enables disaster researchers to examine issues in terms of a dynamic, interconnected collection of components.
- Recognises how macro (individuals/households), meso and micro levels factors (organizational/community and societal) influence its operation.

Systems thinking and complexity



Systems thinking and complexity

Complex research questions require methods that unpack various influences that interact across multiple levels of society.

Different tenets of complexity that are characteristic of complex adaptive systems:

- Dynamic context
- Interconnectivity
- Emergence
- Self-organization
- Adaptability
- Feedback loops
- Non-linearity

Systems thinking and complexity

- Complex systems can develop or change internal structure spontaneously and adaptively to cope with their environment.
- In the absence of structure/protocols, self-organization naturally follows change in social systems.
- Impacts of changing context within a system are non-linear and feedback loops provide important information about operational functioning.

Application of complexity theory to social networks in pandemic prevention, preparedness, response and recovery

Tenet of complexity	Application
Interconnectivity	Interconnectivity is inherent in relationships, partnerships and strong social networks. Effective pandemic response is dependent on actors from different parts of the health system working together; communication, which is a connective activity is central in pandemic prevention, preparedness, response and recovery.
Dynamic context	Social networks are dynamic. People change positions, retire or meet new people, and the relationships within the network change. People also develop new expertise and experience, which contributes to the dynamic nature of the entire system.
Emergence	Knowledge and ideas emerge within social networks. Behaviours also emerge and influence social norms within networks – both positive and counter-productive. Emergence can spark innovation and contribute to different intervention strategies.
Feedback loops	Social networks provide opportunities for feedback from different parts of the system. This feedback loop creates opportunities for networking, relationship building, and co-learning.
Self-organization	Networks contribute to self-organization in the absence of clear policies or plans which outline roles and responsibilities. When structure and information are needed, but missing, people self-organize to create structure and fill the gaps. Self-organization can support pandemic response and recovery, but in vaccination campaigns, it can also hinder formal processes and awareness campaigns if not managed.
Non-linearity	Social networks are non-linear. Social media is a good example of how social networks do not develop in linear patterns. Communication and influence within social networks are dependent on the relationships and connections of each actor. Non-linearity prohibits cause-effect relationships from being established.

Case Study: *Advancing performance measurement for public health emergency preparedness*

Understanding levels of preparedness in advance of a disaster is an important knowledge gap in Health EDRM, which is important given increasing frequency of emergencies and value of defining and measuring preparedness to guide improvement.

Topic suited to a two-phase mixed methods study to address:

- how do we know if we are prepared?
- how do we measure it?

Case Study: *Advancing performance measurement for public health emergency preparedness*

Initial exploration aimed at defining emergency preparedness for public health system in Canada: achieved using a qualitative study design.

Rich qualitative data were analyzed using complex adaptive systems lens to develop a framework defining essential elements of a resilient public health system.

Framework reflects complexity of role of public health sector in emergencies and was used to ensure approach to measurement considered what the system is aiming to do.

Case Study: *Advancing performance measurement for public health emergency preparedness*

Framework elements informed a mixed methods Delphi survey to develop indicators for public health emergency preparedness.

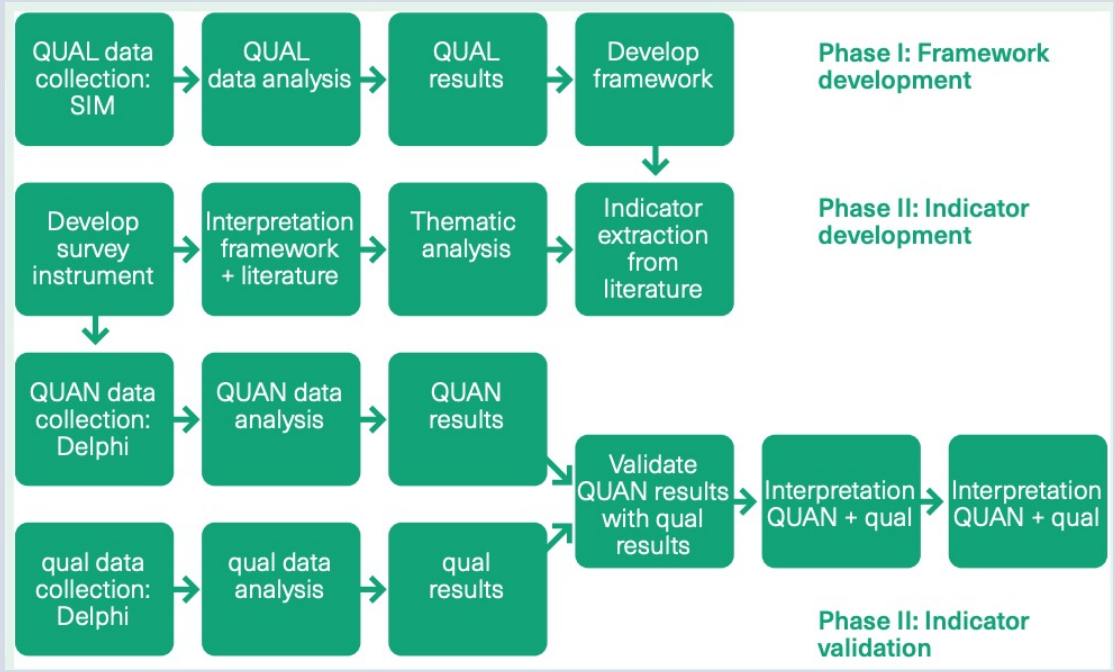
Study was a combination of:

- Deductive thematic analysis of literature
- Open ended questions for comments on indicators and suggestions for new indicators
- Quantitative rating of indicators

Enabled development of list of preparedness indicators

Case Study: *Advancing performance measurement for public health emergency preparedness*

Sequence and combination of mixed methods approaches for two phases:



Key messages

- Mixed methods combines quantitative and qualitative methods and has evolved into a third type of methodology which can provide a more comprehensive explanation for the complexity inherent in disaster research.
- Systems thinking in disaster health research focuses on interactions of factors across macro, meso and micro levels of society.
- Integration of data, analysis and findings in mixed methods studies is central to the methodology.
- Challenges and practical considerations for designing and implementing mixed method research include theoretical and epistemological differences between methodologies.

Further readings

Creswell JW. A Concise Introduction to Mixed Methods Research. Thousand Oaks, CA: SAGE; 2015.
In this short textbook, the author introduces mixed methods research, with a focus on social, behavioral, and health science. It describes the theories and principles behind mixed methods research and illustrates the steps of executing a mixed methods study. The textbook also provides guidance on evaluating the quality of a mixed methods study and preparing a manuscript for publication.

Creswell JW, Plano Clark VL. Designing and Conducting Mixed Methods Research (2nd edition). Los Angeles: Sage Publishing; 2011.
In this textbook, the authors introduce the design and execution of mixed methods studies. It outlines seven mixed method study designs and includes published examples of each design. The textbook is structured to follow the study design and execution process, beginning with initial assessments and concluding with preparing a final report.

Further readings

Gunderson LH, Holling CS, editors. Panarchy, Washington, US: Island Press; 2002.
In this collection of scholarly essays, the authors take a systems-based approach to understanding environmental management. It argues that adaptive environmental management should focus on the idea of panarchy, an evolving hierarchy that integrates natural, human, and human-natural systems. The book explains the theory of panarchy, existing models, and how it can guide practical environmental management interventions. The book concludes that identifying the structure of panarchies can allow researchers to better locate targets for resilience and sustainability interventions.

Johnson RB, Schoonenboom J. Adding Qualitative and Mixed Methods Research to Health Intervention Studies: Interacting With Differences, Qualitative Health Research; 2016: 26(5): 587-602.
In this short article, the authors outline how qualitative and mixed methods research can be introduced to health intervention research through the theory of dialectical pluralism.

Further readings

O'Cathain A, Murphy E, Nicholl J. Three techniques for integrating data in mixed methods studies BMJ; 2010: 341: c4587

In this short article, the authors provide three approaches to incorporating data into mixed methods research. It outlines triangulation, "following a thread," and mixed methods matrices as approaches to combining the strengths of qualitative and quantitative research.

Palinkas L, Aarons G, Horwitz S, Chamberlain P, Hurlburt M, Landsverk J. Mixed Method Designs in Implementation Research. Administration and Policy in Mental Health; 2011: 38: 44–53.

In this short article, the authors describe approaches used in mixed method implementation research in recent literature. The authors identified 22 articles published between 2005 and 2009. The articles used seven different structural arrangements, five mixed methods functions, and three ways of integrating quantitative and qualitative data.

References

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Definition of mixed methods research: Johnson RB, Onwuegbuzie AJ, Turner LA. Toward a Definition of Mixed Methods Research. Journal of Mixed Methods Research; 2007: 1(2): 112–33.

QUAN/QUAL weighting method: Palinkas L, Aarons G, Horwitz S, et al. Mixed Method Designs in Implementation Research. Adminstration and Policy in Mental Health 2011: 38: 44–53.; Creswell JW, Plano Clark VL. Designing and Conducting Mixed Methods Research (2nd Edition). Los Angeles: Sage Publications Inc.; 2011.

Perceptions of earthquake survivors in Amatrice, Italy case study: Massazza A, Brewin CR, Joffe H. The Nature of "Natural Disasters": Survivors' Explanations of Earthquake Damage. International Journal of Disaster Risk Science; 2019: 10(3): 293-305.

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Complexity of systems: Cilliers P. Complexity and postmodernism: Understanding complex systems. London: Routledge; 1998.

Influence of macro, meso and micro levels factors on systems: Bergström J, Dekker SWA. Bridging the Macro and the Micro by Considering the Meso: Reflections on the Fractal Nature of Resilience. Ecology and Society; 2014: 19(4): 22.; *and* Luhmann N. Introduction to Systems Theory, English Edition, Cambridge, UK: Polity Press; 2013

Advancing performance measurement for public health emergency preparedness case study: Khan Y, O'Sullivan T, Brown A, Tracey S, et al. Public health emergency preparedness: A framework to promote resilience. BMC Public Health; 2018: 18(1): 1344.; *and* Khan Y, Brown A, Gagliardi A, et al. Are we prepared? The development of performance indicators for public health emergency preparedness using a modified Delphi approach. PLoS ONE; 2019: 14(12): e0226489.

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