



MONASH University

Disaster Risk Reduction and the Social Determinants of Health

Joseph Cuthbertson
MPH, MEH, MSc

This thesis is submitted in fulfillment of the requirements for the Degree of
Doctor of Philosophy

Monash University
Monash University Accident Research Centre
Monash University Disaster Resilience Initiative
Victoria, Australia

2022

COPYRIGHT NOTICE

© Joseph Cuthbertson 2022

I certify that I have not knowingly added copyright content to my work without the author's permission.

DECLARATION

Thesis including published works declaration

I hereby declare that this thesis contains no material which has been accepted for the award of any other degree or diploma at any university or equivalent institution and that, to the best of my knowledge and belief, this thesis contains no material previously published or written by another person, except where due reference is made in the text of the thesis.

This thesis includes six (6) original papers published in peer reviewed journals and two (2) position statements published by international professional organisations. The core theme of the thesis is disaster risk and the social determinants of health. The ideas, development and writing up of all the papers in the thesis were the principal responsibility of myself, the student, working within the Monash University Disaster Resilience Initiative under the supervision of Emeritus Professor Frank Archer.

In the case of chapters 5.5.2, 5.7.2.2, 5.9.2, 5.9.3, 5.10.2, 6.3.2, 6.4.2 my contribution to the work involved the following:

Thesis Chapter	Publication Title	Status (published, in press, accepted or returned for revision)	Nature and % of student contribution	Co-author name(s) Nature and % of Co-author's contribution*	Co-author(s), Monash student Y/N*
5.5.2	Improving Disaster Data Systems to Inform Disaster Risk Reduction and Resilience Building in Australia: A Comparison of Databases	<i>Published</i>	<i>60%. Concept development collecting data and writing</i>	<ul style="list-style-type: none"> ○ Frank Archer , input into manuscript 15% ○ Jose Rodriguez, input into manuscript 15% ○ Andy Robertson, input into manuscript 10% 	<i>No</i>
5.7.2.2	Current and Emerging Disaster Risks Perceptions in	<i>Published</i>	<i>60%. Concept development</i>	<ul style="list-style-type: none"> ○ Frank Archer , input into manuscript 15% 	<i>No</i>

	Oceania: Key Stakeholders Recommendations for Disaster Management and Resilience Building		<i>collecting data and writing</i>	<ul style="list-style-type: none"> ○ Jose Rodriguez, input into manuscript 15% ○ Andy Robertson, input into manuscript 10% 	
5.9.2	Position Statement World Association of Disaster and Emergency Medicine Climate Change	<i>Published</i>	<i>70%. Concept development and writing</i>	<ul style="list-style-type: none"> ○ Frank Archer , input into manuscript 10% 	No
5.9.3	Special Report: WADEM Climate Change Position Statement	<i>Published</i>	<i>70%. Concept development collecting data and writing</i>	<ul style="list-style-type: none"> ○ Frank Archer , input into manuscript 20% ○ Andy Robertson, input into manuscript 10% 	No
5.10.2	Health Impacts of Volcanic Activity in Oceania	<i>Published</i>	<i>80%. Concept development collecting data and writing</i>		No
6.3.2	Non-traditional health threats: redefining the emergency management landscape	<i>Published</i>	<i>60%. Concept development collecting data and writing</i>	<ul style="list-style-type: none"> ○ Frank Archer , input into manuscript 15% ○ Jose Rodriguez, input into manuscript 15% ○ Andy Robertson, input into manuscript 10% 	No
6.4.2	Societal disruption as a disaster. Exploring suicide, addiction and domestic violence in Australia through a disaster risk reduction lens	<i>Published</i>	<i>60%. Concept development collecting data and writing</i>	<ul style="list-style-type: none"> ○ Frank Archer , input into manuscript 15% ○ Jose Rodriguez, input into manuscript 15% ○ Andy Robertson, input into manuscript 10% 	No

I have not renumbered sections of submitted or published papers in order to generate a consistent presentation within the thesis.

Student signature: *J Cuthbertson*

Date: 22.03.2022

The undersigned hereby certify that the above declaration correctly reflects the nature and extent of the student's and co-authors' contributions to this work. In instances where I am not the responsible author, I have consulted with the responsible author to agree on the respective contributions of the authors.

A handwritten signature in black ink, appearing to be 'J. Cuthbertson', written over a horizontal line.

Main Supervisor signature:

Date: 22.03.2022

ABSTRACT

Disaster risk reduction encompasses practices that reduce exposure to hazards and decrease vulnerability of people and the environment. Such practices are founded on systematic efforts to identify and analyse the causal factors of disasters, rather than apply response designed actions post event. These initiatives represent close alignment with public health practice; further examination of this alignment may assist in strengthening disaster risk reduction and management planning.

This PhD examined how the outcomes of disaster events upon an individual and/or a community is related to their underlying determinants of health. The assessment of the relationship of proposed strategies and the Social Determinants of Health facilitated by this PhD provides insight to an improved, holistic approach to disaster practice.

The PhD plan was designed as a logical progression from exploring and profiling emerging disaster risk, to exploring the relationship of health determinants and disaster risk. Two (2) stages of research were applied in this PhD to guide this progression. Stage 1 profiled emerging disaster risk In Oceania; Stage 2 investigated the findings discovered in Stage 1 and considered their relationship to the social determinants of health in disaster risk reduction with targeted inquiry and research within Australia .

To achieve this, in stage 1, research and analysis of emerging disaster risks in Oceania was undertaken at the Centre for Research and Epidemiology in Disasters (CRED), an internationally recognised institution providing commentary and analysis on disasters to Global health (WHO) and disaster management (UNSIDR) institutions. This research provided an output of contemporary themes, a variety of event specific data and social demographic data related to Oceania. Interviews were then conducted with national and international disaster health management experts on their perceptions of current and emerging risks. This inquiry informed the changing profile of disaster risk and health impacts within Oceania

Following this, Stage 2 was conducted to understand how the Social Determinants of Health relate to disaster risk and community perception of risk. The impact of disasters in reference to the Social Determinants of Health were tested via a study applying a qualitative interview of community members in a small Western Australian town and a quantitative assessment of health metrics sourced from the Australian Bureau of Statistics. This stage undertook a more targeted approach than the previous stage to deeply explore sense of risk at a community level.

This research found that examining emerging disaster risks are not well defined or measured in contemporary disaster databases. Further to this, non-traditional threats were also not captured. Non-traditional health threats and impacts causing societal disruption were a feature of the research undertaken in this PhD. Emerging disaster risks in Oceania are not captured by traditional disaster definitions and classification methodology or in existing disaster databases. The investigation of the Social Determinants of Health and disaster risk reduction demonstrated that strong social connection within the community

enhances disaster risk awareness and preparedness and that stress and social exclusion from the community increased an individual's vulnerability to disaster. Disaster resilience is a function of good physical and mental health; and effective disaster planning required community partnership in the development, education, and testing, with robust communication as an essential trait of communication plans. These findings provide insight as to how determinants of health are related to vulnerability in disaster, and warrant attention from international and national policy makers to improve the health status of populations and reduce disaster risk.

ACKNOWLEDGEMENTS

This research is dedicated to the men, women, and children from the many communities across Oceania who have already experienced, or may in the future experience, the effects of a disaster. These people face difficult and frightening circumstances and sometimes suffer enormous loss.

Resilience and vulnerability are contextual to different communities, who best understand the risks they face. They deserve the support and encouragement to be better prepared. Achieving this requires their partnership to share awareness of risk and engagement on countermeasures to mitigate them.

To the emergency management and disaster health leaders and practitioners and the community members who shared their time with me I am incredibly grateful. Their time, trust and willingness to talk to me allowed me to complete this research.

I would not have been able to complete this work if it had not been for the wisdom, support and guidance of my family, colleagues at the Monash University Disaster Resilience Initiative (MUDRI), and supervisory team Frank Archer, Andrew Robertson and Jose Rodriguez. I thank Monash University for accepting me as a PhD candidate, and for their support for this research.

TABLE OF CONTENTS

COPYRIGHT NOTICE	2
DECLARATION	3
ABSTRACT	6
ACKNOWLEDGEMENTS	8
TABLE OF CONTENTS	9
LIST OF TABLES	15
LIST OF FIGURES	16
GLOSSARY	17
PROLEGOMENON	18
1 SETTING THE SCENE FOR THIS RESEARCH	19
1.1 INTRODUCTION	19
1.2 PROBLEM STATEMENT	20
1.3 INITIAL RESEARCH AIMS	21
1.4 THE TWO STAGES OF THIS RESEARCH	22
1.5 STRUCTURE OF THE THESIS	23
1.6 SUMMARY	24
2 THE FOCUS OF THIS RESEARCH	25
2.1 INTRODUCTION	25
2.2 REASONS TO UNDERTAKE THIS RESEARCH	25
2.2.1 A Health in Disasters focus	25
2.2.2 The need to define disaster impact	26
2.3 KEY CONCEPTS IN THE LITERATURE AND INTERNATIONAL CONSENSUS STATEMENTS INTERSECTION	27
2.3.1 Community Resilience	27
2.3.2 A National Strategy for Disaster Resilience	29
2.3.3 Disaster Risk, Risk Reduction and Mitigation	30
2.3.4 Sendai Framework for Disaster Risk Reduction	30
2.3.5 The Australian National Disaster Risk Reduction Framework	34

2.3.6	Social Determinants of Health	34
2.3.7	The Sustainable Development Goals	36
2.3.8	International Consensus Frameworks	37
2.4	CONCLUSION AND REVISED RESEARCH QUESTIONS	41
3.	A CONCEPTUAL FRAMEWORK TO STRUCTURE THE RESEARCH	43
3.1	INTRODUCTION	43
3.2	DEVELOPING A CONCEPTUAL FRAMEWORK	43
3.2.1	Assumptions and inclusions	46
3.3	SUMMARY	47
4	OVERVIEW OF RESEARCH DESIGN USED IN THIS RESEARCH	48
4.1	INTRODUCTION	48
4.2	KEY ELEMENTS OF THE RESEARCH DESIGN	48
4.3	DEVELOPING RESEARCH TOOLS	48
4.3.1	Practitioner based interviews - locations and participant sampling	48
4.3.2	Community based fieldwork – sites and participant sampling	48
4.4	DATA COLLECTION	48
4.4.1	Participant engagement	48
4.4.2	Semi-structured interviews	49
4.5	DATA ANALYSIS	49
4.6	ETHICAL AND GOVERNANCE CONSIDERATIONS	49
4.7	CONCLUSION	49
5.	STAGE 1: PROFILING EMERGING DISASTER RISK IN OCEANIA	51
5.1	INTRODUCTION	51
5.2	STAGE 1 RESEARCH DESIGN AND METHODOLOGY	51
5.2.1	Rationale	51
5.2.2	Research questions and literature review	51
5.2.3	Design	53
5.2.4	Methodology	53
5.3	STAGE 1 QUANTITATIVE DATA ANALYSIS	53

5.3.1	Introduction	53
5.3.2	Centre for Research on the Epidemiology of Disasters, Emergency Events Database, access, and usage.	53
5.3.3	Hazard and Peril Glossary	54
5.3.4	Categorisation of Disasters	55
5.3.5	Emergencies of Scarcity, International Union for Conservation and Nature Commission on Ecosystem Management Resilience Thematic Group	55
5.3.6	Discussion on international disaster data recording	57
5.4	AUSTRALIAN DISASTER HUB	57
5.4.1	Disaster Mapper	57
5.5	IMPROVING DISASTER DATA SYSTEMS TO INFORM DISASTER RISK REDUCTION AND RESILIENCE BUILDING IN AUSTRALIA: A COMPARISON OF DATABASES	57
5.5.1	Introduction	57
5.5.2	Peer reviewed published paper: Improving disaster data systems to inform disaster risk reduction and resilience building in Australia: a comparison of databases	58
5.5.3	Discussion	67
5.6	STAGE 1 QUALITATIVE DATA ANALYSIS	67
5.6.1	Introduction	67
5.6.2	Methodology	67
5.6.3	Discussion	80
5.7	STUDY 1: PERCEPTIONS OF DISASTER RISK IN OCEANIA	81
5.7.1	Introduction	81
5.7.2	Current and Emerging Disaster Risks Perceptions in Oceania: Key Stakeholders Recommendations for Disaster Management and Resilience Building.	81
5.7.2.1	Introduction	81
5.7.2.2	Peer reviewed published paper: Current and Emerging Disaster Risks Perceptions in Oceania: Key Stakeholders Recommendations for Disaster Management and Resilience Building	82
5.7.2.3	Discussion	95
5.8	STUDY 1 EXTENSION: DISASTER RISK IN THE PACIFIC	96

5.8.1	Introduction	96
5.8.2	Rationale and methodology	96
5.8.3	Results	97
5.8.4	Discussion	104
5.9	CLIMATE CHANGE RISK	105
5.9.1	Introduction	105
5.9.2	Published Position Statement World Association of Disaster and Emergency Medicine Climate Change	107
5.9.3	Peer reviewed published paper: Special report WADEM Climate Change Position Statement	110
5.9.4	Discussion	114
5.10	VOLCANO RISK IN OCEANIA	116
5.10.1	Introduction	116
5.10.2	Peer reviewed published paper: Health Impacts of Volcanic Activity in Oceania	117
5.10.3	Discussion	123
5.11	STAGE 1 DISCUSSION	123
5.11.1	Strengths	123
5.11.2	Weaknesses including potential bias	123
5.12	STAGE 1 CONCLUSION	124
6.	STAGE 2: THE SOCIAL DETERMINANTS OF HEALTH IN DISASTER RISK REDUCTION	125
6.1	INTRODUCTION	125
6.2	STUDY 2: WESTERN AUSTRALIAN COMMUNITY STUDY, HEALTH AND DISASTER RISK	
6.2.1	Introduction	125
6.2.2	Rationale	125
6.2.3	Design	126
6.2.4	Research questions and literature review	126
6.2.5	Australian Disaster Inquiries and Reports, a Social Determinants of Health lens	131
6.2.6	Study 2 Methodology	145
6.2.7	Results	145

6.2.8	Discussion	157
6.2.9	Conclusion	163
6.3	NON-TRADITIONAL DISASTERS AND HEALTH THREATS	163
6.3.1	Introduction	163
6.3.2	Peer reviewed published paper: Non-traditional health threats: redefining the emergency management landscape	164
6.3.3	Discussion	171
6.4	SOCIETAL DISRUPTION AS A DISASTER. EXPLORING SUICIDE, ADDICTION AND DOMESTIC VIOLENCE IN AUSTRALIA THROUGH A DISASTER RISK REDUCTION LENS	
6.4.1	Introduction	171
6.4.2	Peer reviewed published paper: Societal disruption as a disaster. Exploring suicide, addiction and domestic violence in Australia through a disaster risk reduction lens	171
6.4.3	Discussion	184
6.5	STAGE 2 DISCUSSION	184
6.5.1	Strengths	184
6.5.2	Weaknesses including potential bias	185
6.5.3	Reflections on health and disaster risk reduction	185
6.6	STAGE 2 CONCLUSION	185
7.	THESIS DISCUSSION	187
7.1	INTRODUCTION	187
7.2	SUMMATION OF KEY FINDINGS OF THIS RESEARCH	187
7.2.1	Key domains of disaster risk measurement	188
7.2.2	Key domains of community disaster risk management	188
7.2.3	Factors that support or hinder community disaster risk management	188
7.2.4	Key findings related to research conceptual framework	189
7.2.5	The value of population health related to disaster risk reduction	190
7.3	IMPLICATIONS FOR FUTURE POLICY AND PRACTICE	191
7.4	IMPLICATIONS FOR FUTURE RESEARCH	191
7.5	IMPLICATIONS FOR COMMUNITIES	192
7.6	LIMITATIONS	192

8. THESIS CONCLUSION	194
BIBLIOGRAPHY	195
APPENDICES	205
APPENDIX A: STAGE 1 - ETHICS DOCUMENTATION	205
Explanatory statement	205
Consent form	207
Theme list of interview Questions	208
APPENDIX B: STAGE 2 - ETHICS DOCUMENTATION	210
Explanatory statement	209
Consent form	213
Theme list of interview Questions	214
APPENDIX C: WADEM Position Statement: Accurate reporting of public health information	217
APPENDIX D: Australian Journal of Emergency Management Monograph No 5 December 2019 AFAC19 Extended abstracts from the Bushfire and Natural Hazards CRC Research Forum Climate change as an emerging disaster risk in Australia and Oceania.	218

LIST OF TABLES

Table 1	The Sustainable Development Goals and The Sendai Framework for Disaster Risk Reduction
Table 2	Intersection and linkage of the Social Determinants of health, the Sustainable Development Goals and The Sendai Framework for Disaster Risk Reduction
Table 3	Five themes developed from seven codes with illustrative data extracts (direct quotes)
Table 4	Operation Recovery Task Force (Cyclone Larry 2007) recommendations and The Social Determinants of Health overarching recommendations comparison
Table 5	2009 Victorian bushfires Royal Commission recommendations and The Social Determinants of Health overarching recommendations comparison
Table 6	2010–11 Flood Warnings & Response (Victoria, Australia) recommendations and Social Determinants of Health overarching recommendations comparison
Table 7	A Shared Responsibility Perth Bushfires recommendations and The Social Determinants of Health overarching recommendations comparison
Table 8	2012 Queensland floods commission of inquiry recommendations and Social Determinants of Health overarching recommendations comparison
Table 9	2013 Tasmanian Bushfires Inquiry recommendations and The Social Determinants of Health overarching recommendations comparison
Table 10	Hazelwood Mine Fire Inquiry (2014) recommendations and The Social Determinants of Health overarching recommendations comparison
Table 11	Royal Commission into National Natural Disaster Arrangements (2020) recommendations and Social Determinants of Health overarching recommendations
Table 12	Summary report of inquiry recommendations that aligned with the Social determinants of health overarching recommendations
Table 13	Dwellingup 2016 Census demographics
Table 14	SEIFA scores, Murray Western Australia - Wheatbelt
Table 15	Five themes developed from seven codes with illustrative data extracts

LIST OF FIGURES

Figure 1	Seven Targets to achieve by 2030
Figure 2	Temporal introduction of key International Consensus Frameworks
Figure 3	Conceptual framework
Figure 4	Royal Commission into National Natural Disaster Arrangements 'Elements of disaster risk associated with natural hazards'

GLOSSARY

CSIRO	The Commonwealth Scientific and Industrial Research Organisation
IPCC	The Intergovernmental Panel on Climate Change
MUARC	Monash University Accident Research Centre
MUDRI	Monash University Disaster Resilience Initiative
MUHREC	Monash University Human Research Ethics Committee
NDRS	National Disaster Resilience Strategy
NDRRF	National Disaster Risk Reduction Framework
NEMC	National Emergency Management Committee
PER	Program Evaluation Report
PPRR	Prevention, Preparedness, Response, Recovery
SOPAC	South Pacific Applied Geoscience Commission
UNDRR	United Nations Office for Disaster Risk Reduction
UNFCCC	The United Nations Framework Convention on Climate Change
UNISDR	United Nations International Strategy for Disaster Reduction
UNOCHA	United Nations Office for the Coordination of Humanitarian Affairs

PROLEGOMENON

About the author:

Joe resides in Perth, Western Australia (WA), and is employed as Head of Specialist Operations for St John Ambulance Western Australia. He has worked in the prehospital field for the last 20 years in a broad range of clinical, governance and management roles and undertook this thesis as a part time candidate. Prior to that, Joe worked as a Clearance Diver with the Royal Australian Navy. Joe is currently a Board member for the World Association of Disaster and Emergency Medicine (WADEM), the chair of the WADEM Oceania chapter, is on the editorial board of Prehospital and Disaster Medicine and supports the development and improvement of disaster and emergency health practice through education, service and research.

During PhD candidature Joe published the included peer reviewed papers as lead author in international journals and one national journal. The findings of this thesis were presented at Monash departmental forums, the World Congress of Disaster and Emergency Medicine, the International Conference on Healthcare System Preparedness and Response to Emergencies and Disasters, and the Australian and New Zealand National Council for Fire and Emergency Services Conference.

1 SETTING THE SCENE FOR THIS RESEARCH

1.1 INTRODUCTION

Contemporary disaster risk reduction practice identifies that the management of disasters extends beyond the immediate response needs, and that effective recovery from these events requires a broad, coordinated capacity building perspective rather than a traditional short term response effort [1, 2]. This includes design of interventions that prioritises health, determines extent of impact, evaluates damage, and determines capacity of local infrastructure [3, 4].

The United Nations Sendai Framework for Disaster Risk Reduction endorses a comprehensive approach to reduce disaster risk. This framework, under the auspices of the United Nations Office for Disaster Risk Reduction (UNDRR) provides guidelines for Governments, organizations and civil society actors of activities that strengthen community and population resilience to the effects of disasters.

The World Health Organization (WHO) Risk Reduction and Emergency Preparedness strategy for the health sector and community capacity development reflects the recommendations of a global consultation organised by the Health Action in Crisis cluster. Since 2005 WHO, within its role as health cluster lead, has implemented planning processes to strengthen emergency preparedness and response activities specifically targeting action at a community level. This strategic framework signals a shift from traditional, short term focussed emergency management doctrine to one of capacity building, developing resilience and reducing vulnerability. The challenge in achieving this goal, as described by the strategic framework is ‘establishing systematic capacities, such as legislation, plans, coordination mechanisms and procedures, institutional mechanisms and budgets, skilled personnel, information and public awareness and participation that can measurably reduce future risks and losses’[5]. This strategy also recognizes the importance of applying a ‘whole of health’ approach and utilizes the WHO definition of health as the benchmark for intervention effectiveness. This strategic direction complements efforts in other areas of nation building, notably sustainable development.

The overall guiding principle for this strategy is that ‘risk reduction and emergency preparedness is the responsibility of all sectors at all levels’. Further principles supporting these are:

- Risk reduction and emergency preparedness are part of the development process.
- An all-hazard approach is essential.
- Risk reduction and emergency preparedness are the responsibility of all national actors.
- Emergency preparedness requires a multi sectoral approach
- Priority on technical assistance[5].

Further goals and objectives support these principles and outline the action, monitoring and evaluation required to fulfil this strategy's mandate.

This six-year strategy was initiated in 2006. 2012 did not complete the mandate of this strategy; however, the ambition of this work aligns with the aims and goals of broader disaster risk reduction action and is complementary to other actors striving forward in this field. It is notable that the 'whole of health' approach and the use of the WHO health definition is incorporated within this policy. The use of health standards in disaster risk reduction can contribute to producing interventions that build community strength thereby enhancing mechanisms of coping and resilience when faced with adversity.

Progress has begun in this area with the development of the World Health Organisation Health Emergency And Disaster Risk Management Framework[6]. Health Emergency and Disaster Risk Management (Health-EDRM) recognises the complementary and connected fields of emergency and disaster medicine, DRR, humanitarian response[7]. In order to achieve the outcomes of the Sendai Framework for Disaster Risk Reduction the Health Emergency And Disaster Risk Management Framework was implemented by the World Health Organisation to guide multisectoral disaster risk management, and all-hazards emergency preparedness and response, and emphasises the need for an 'whole of health' approach to preventing and reducing harm caused by disasters[6].

1.2 PROBLEM STATEMENT

This thesis sought to examine what disaster risk future communities face and how they are measured, and how health status informed disaster risk.

Such findings are of importance at a national level and have been the subject of numerous governmental inquiries. The Royal Commission into National Natural Disaster Arrangements reported that climate change has already increased the frequency and intensity of extreme weather and climate systems that influence natural hazards[8]. The National Strategy for Disaster Resilience[9] also identifies that disasters are increasing in their complexity and frequency. Priorities of prevention and mitigation embedded within this strategy are proposed to mitigate the effects of disasters upon the community.

Contemporary evidence suggests that a systematic effort to analyse and manage the causal factors of disasters could achieve disaster risk reduction, rather than using traditional management processes [10-12]. To understand the causal factors of disasters, broader risk analysis is required that is future focussed and considers exposure to hazards, vulnerability of people and property, management of land and the environment, community resilience and preparedness for adverse events. Robust (or lack thereof) determinants of health may influence the outcomes of disaster events upon an individual and/or a community. To advance current thinking, this research explores emerging disaster risk and the relationship of the Social Determinants of Health and to disaster.

To achieve this, two (2) problem statements were constructed with relevant problem sub statements, to guide the studies undertaken.

Problem Statement 1:

Disasters continue to increase around the world in frequency, magnitude and societal cost. To advance the science and evidence-base of disaster risk improved forecasting of emerging disaster risk is required.

Problem Statement 1, sub statement 1:

Emerging disaster risks may not be associated with previous hazards, assessment of harm upon communities and whether it is contextualised as a disaster and doing so consideration of the application of disaster risk management to inform risk control is warranted.

Problem Statement 2:

The causal factors of health and how they relate to disaster vulnerability of a population is poorly understood.

The initial research question of this PhD was to investigate emerging risk definition and data capture with a focus on Oceania and the Pacific. Perceptions of the relationship between disaster risk reduction practice and the Determinants of Health were explored, and in doing so considered the application of the Social Determinants of Health as a holistic approach to disaster risk reduction.

1.3 INITIAL RESEARCH AIMS

The premise of this research is that the effects of impacts of disasters is related to a person's and communities pre-existing vulnerability that is driven with health status and health determinants. Examination of how the Social Determinants of Health influence disaster impact is an emerging field of research with several authors identifying determinants such as poverty and gender related to disaster risk. Further investigation is required to understand to what extent determinants influence disaster risk, whether relationships between determinants increases or decreases risk, or have no effect.

Developing this knowledge base is valuable to inform strategies to protect communities from current and future disaster risks. The effects of the COVID-19 pandemic have shown greater need than ever for this knowledge, whilst the mantra of disaster recovery to date has been 'build back better', the experience of the current pandemic and the disproportionate effects upon the most vulnerable within communities. A review of the impacts of COVID-19 by Marmot et al proposed re framing of recovery such that we build 'back fairer', rather than 'better' to address health inequities to improve resilience[13].

This research used mixed methods to determine emerging disaster risk in Oceania and explore relationships of health determinants and disaster risk in an Australian community.

The aim of this research is twofold. Traditional emergency management-based frameworks employ hazard and risk analysis in the development of preparedness, response and recovery plans. This analysis is invariably based on historical data of event impact. The nature, scale and type of disasters are changing globally [12, 14]. The emergence of new disaster types, the re-emergence of former health risks and the development on non-traditional threats requires broader investigation of future disaster threats to population health.

The first aim of this study was to profile emerging disaster risk in Oceania. The rationale for undertaking the first stage of this research is to investigate non-traditional threats to the health and wellbeing of societies associated with disaster impact. Emerging disaster risks are poorly understood. Without clear evidence readiness, to accept future threats is low resulting in delayed strategic planning for adaptation or response. The role of the analysis is to examine what emerging disaster risk evidence exists to support decision making and profile the nature, type and potential human and economic impact of emerging disaster risk.

The second aim of this research was to examine whether appropriate disaster risk reduction practice is a determinant of population health that could act as a framework for disaster practice users to ensure actions are effective in improving community health status. The rationale for undertaking the second stage of this research is to investigate how causal factors of population health relate to, and impact upon disaster risk, resilience, vulnerability, impact, and recovery. The multi-disciplinary environment that contextualises disaster practice has the capacity to influence determinants of health. Current responses to address disaster risk independently by disciplines may be redundant or, at worst, conflicting. Identification of this influence, and coordination of programmed effort between disciplines has the potential to enhance societal wellbeing and reduce the human and economic costs associated with disasters.

1.4 THE TWO STAGES OF THIS RESEARCH

The first stage of this research was to undertake investigation of new and emerging disaster risks. This was initiated by a literature review undertaken for this theme in two parts.

- A review of the peer reviewed literature tracing the development of disaster risk. The following databases were searched: PubMed/Medline; Cinahl Plus; EMBASE; Proquest; Science Web; Scopus and Web of Knowledge. Searches were made utilising the terms; 'disaster risk', 'emerging risk', 'disaster', 'disaster resilience', and 'disaster risk reduction'. The following criteria were used to identify material that would be included: published in peer reviewed journal and published in the English language. Exclusion criteria included: non peer reviewed papers and abstracts.
- A review of the "grey literature" using similar key words. The literature review has been informed by a consideration of policy related to sustainable development, the social determinants of health, and health improvement and disaster risk reduction

agenda described by the World Health Organisation (WHO) and the United Nations Office for Disaster Risk Reduction (UNDRR).

The findings from these two literature reviews were informative and the results of which are embedded in the study findings and published papers.

Following this, a thematic analysis using semi-structured telephone interviews via Skype or phone with international experts in disaster and emergency management was conducted. This utilised a theme list informed by the literature reviews. The interviews were recorded, transcribed and a thematic analysis was undertaken.

Quantitative analysis of data obtained during a visit to the Center for Research and Epidemiology in Disasters (CRED) examining historical and contemporary trends in disasters in Oceania was conducted.

The second stage of this research was to undertake investigation of the Social Determinants of Health and disaster risk. This was utilised a similar approach to the first stage using a literature review undertaken in two parts

- A review of the peer reviewed literature tracing the development of disaster risk and health. The following databases were searched: PubMed/Medline; Cinahl Plus; EMBASE; Proquest; Science Web; Scopus and Web of Knowledge. Searches were made utilising the terms; 'disaster resilience', 'health', 'disaster health,' 'social determinants of health,' and 'disaster risk reduction'. The following criteria were used to identify material that would be included: published in peer reviewed journal and published in the English language. Exclusion criteria included: non peer reviewed papers and abstracts.
- A review of the "grey literature" using similar key words. The literature review has been informed by a consideration of policy related to sustainable development, the social determinants of health, and health improvement and disaster risk reduction agenda described by the World Health Organisation (WHO) and the United Nations Office for Disaster Risk Reduction (UNDRR).

The findings from these two literature reviews were informative and the results of which are described in Stage 2 findings and published papers.

Following these literature reviews, semi-structured interviews involving community members in an area with a pre-existing identified disaster risk were conducted. This utilised a theme list informed by the literature reviews. The interviews were recorded, transcribed and a thematic analysis was undertaken. The outcomes of the thematic analysis were contextualised in reference to the Australian Bureau of Statistics quantitative assessment of social and economic determinants of the local community.

1.5 STRUCTURE OF THE THESIS

This thesis is structured in a logical stepwise progression of the research undertaken for both themes and links how relevant outputs (peer reviewed articles, conference presentations and engagement in disaster science programs) relate to theme exploration and conclusions derived.

Chapter one provides an overview of the intent of the research and the thesis structure. Chapter two outlines the reasons to undertake the research and key concepts of the literature that informed the project. Chapter three describes the conceptual framework that guided the research undertaken. Chapter four provides an overview of the research design, key elements, sampling and data management methods, analysis and ethical considerations related to the research. Chapter five reported on the project that profiled emerging disaster risk in Oceania, assessment and analysis of national and international disaster data recording, and focussed reporting of Pacific disaster risk, and climate change and Volcano disaster risk in Oceania. Chapter six provided outcomes of the research undertaken that investigated the relationship of the Social Determinants of Health to disaster risk, and exploration of non-traditional disasters with a focus of societal disruption. Chapter seven describes the key findings of the research against the research aims, problem statements and research questions, and concludes the thesis. This chapter described the structure of this thesis, the next chapter summaries chapter one of this thesis.

1.6 SUMMARY

The purpose of this research was to understand emerging risk related to disaster and whether the Social Determinants of Health inform community disaster resilience and if so, how? This was initiated by identifying key concepts relative to the project and conduct of literature review and research in disaster risk and the social determinants of health. Further focus of this research is undertaken in the next chapter to describe the reasons why this project is important and key literature and policy that informs it.

2 THE FOCUS OF THIS RESEARCH

2.1 INTRODUCTION

Disaster risk is contextualised by contemporary and emerging threats that threatens health status. This research proposes that hazard assessment and forecasting is essential to guide planning that strengthens resilience. The context of this research assumes that individual and population resilience to the effects of disasters are outcomes of their health determinants. This research proposes that understanding health status of people and people's pre-event or pre impact at a determinant level can enable profiling of vulnerability and how it may exacerbate the effects of disaster. Further to this, individual and community perception of how health determinants relate to disaster risk can provide insight into how interventions can be best applied to support populations at risk.

The risk of disasters and their impacts continues to steadily increase around the world in frequency and magnitude[15, 16]. A more integrated approach to prevent and quickly respond against the threat of hazards becoming disasters is urgently needed[17, 18]. These approaches need better rooting within communities, improved understanding of localised vulnerability profiles as well as their local context, which should guide the available capacities and potential solutions available to disaster managers and other involved professionals or the communities themselves.

Current evidence suggests that a systematic effort to analyse and manage the causal factors of disasters is more effective in reducing disaster risk rather than using traditional management processes [19]. Robust (or lack thereof) determinants of health may influence the outcomes of disaster events upon an individual and/or a community. The effects of disasters disproportionally affect vulnerable groups within communities [20]. Marginalised populations due to gender, age, disability, ethnicity, religion or sexual orientation are at greater risk to the impact of a disaster [21]. The concept of examining the causal factors of health and addressing them resonates well with contemporary disaster risk reduction practice. Whilst disaster practice to date has predominantly focussed on emergency management, new thinking proposes that investment in reduction, addressing vulnerability and improving community capacity provides a greater return on investment [20].

The context of this research is to address the knowledge gap in emerging disaster risk, how communities relate disaster risk reduction to their health status and to what extent they perceive drivers of health status as important to being disaster resilient.

2.2 REASONS TO UNDERTAKE THIS RESEARCH

2.2.1 A Health in Disasters focus

Health, as defined by the World Health Organisation (WHO), is the 'complete state of physical, mental, and social wellbeing'[22].

The health of a community extends beyond provision of health care services and programs. The contribution of good governance, education, environment, employment in conjunction with accessibility of health care services are all factors that impact community health and well-being.

The majority of global health care programs to date focus on provision of health care services. This mindset should be challenged to develop and incorporate holistic health care programs addressing social welfare, advocacy, and education. The responsibility of delivery of health outcomes to a community is broader than that of health care disciplines such as doctors, nurses, or allied health professionals. Educators, social and community workers, advocacy professionals and project managers all have roles in contributing to better health outcomes. Empowerment of communities will enable them to manage their own quality of life and health needs and thus reduce the burden on health care services. Ultimately improving community health will require efforts not just from the health sector, but from all the community.

A social determinants analysis of disaster risk (societal hazards) can better prepare our community for health impacts and reduce gaps in social inequality and health equity.

Health in all policies, introduced in South Australia provides a mechanism to ensure all government policies regardless of the nature of the ministerial portfolio are evaluated on their impact on health outcomes and their contribution to reduction in health inequities within society. Development of this approach improves governance through reduction in duplication of effort and coordinates processes in a meaningful manner. This approach is consistent with findings from the Rio +20 UN conference on Sustainable Development, in particular when reviewing potential core health indicators in respect to development planning to reduce health impacts of disasters a suggested indicator included was:

‘proportion of land use, building, infrastructure, and economic development plans that incorporate health impact assessment of disaster related risks into plans and strategies’[23].

Notwithstanding this at the time of project initiation countries and organisations reported least progress on priority 4 of the Hyogo framework for action: to “reduce the underlying risk factors”. Following this the health content of the Sendai Framework for Disaster risk Reduction was greatly increased compared to its forerunner the Hyogo framework[24].

2.2.2 The need to define disaster impact

UNDRR terminology defines disaster impact as ‘the total effect, including negative effects (e.g., economic losses) and positive effects (e.g., economic gains), of a hazardous event or a disaster’[25]. This definition includes consequence of impacts across human, economic, and environmental settings.

The Sendai Framework for Disaster Risk Reduction also notes that the impact of frequent disasters could be cumulative, or become chronic for a community or a society[26].

Disaster impacts are contextual to the hazard type, the vulnerability of the population to the hazard, and the developmental status of the population. Physical impacts such as mortality

and morbidity, and infrastructure damage are practical to measure and commonly utilised in disaster reporting. Less tangible impacts occurring long after the initial impact phase such as mental health impact and chronic disease are challenging to measure. Further to this slow onset disasters such as drought, small scale disasters that do not meeting international data base criteria and impacts described as ‘intangible losses’ including reduction in productivity, business and /or supply disruption, and social impacts such as education losses are poorly measure if at all. Moreover, one of the greatest deficiencies facing disaster impact assessment is variance in how databases that capture information related to these events define measure and record impacts. This variance results in barriers in research seeking to compare impacts of event types across time and location. The human impact of disasters, published by the Centre for Research and Epidemiology in Disasters (CRED) shows that high income countries are over represented in economic loss related to disaster impact, low and middle-income countries experience greater human impact of disasters[27]. In both settings there will be groups that suffer greater than others, understanding the driver’s vulnerability of those affected can inform strategies to mitigate or prevent disaster impact.

2.3 KEY CONCEPTS IN THE LITERATURE AND INTERNATIONAL CONSENSUS STATEMENTS INTERSECTION

2.3.1 Community Resilience

The United Nations International Strategy for Disaster Reduction defines community resilience as the *“ability of a system, community, or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner including through the preservation and restoration of its essential basic structures and functions (p. 3).”* [25].

In the Australian setting the National Strategy for Disaster Resilience describes four core features of a resilient community: functioning well while under stress; successful adaptation; self-reliance, and social capacity[9].

Community resilience has been shown to be influenced by previous event experience. Nemeth et al noted that memories of a devastating event associated with willingness to help others have resulted in collective behaviour change[28].

The Australian Government Social Inclusion Board defines Community resilience as the capacity of communities to respond positively to crises and the ability of a community to adapt to pressures and transform itself in a way which makes it more sustainable in the future [29]. The Australian Government Social Inclusion Board described social learning, adaptiveness and flexibility as traits of resilient communities.

‘Understanding and Applying the Concept of Community Disaster Resilience: A capital-based approach’ by Mayunga provides an insightful view from an economist’s perspective. To begin with it reviews definitions of resilience, and, like other recent readings it refers to the field of ecology. Of note whilst the common theme of absorption and/or buffering capacity

is present, the concept of an inverse relationship between resilience and vulnerability is questioned. Furthermore, the capacity of a system to evolve or change according to a new environment whilst maintaining function is incorporated into the definition. This adaptability in the context of new, or different systems challenges the theory of absorption and buffering. In fact, by this theory a system could be both vulnerable and resilient. The paper refines community resilience into elements of capital: social, economic, human, physical and natural capital; and then proposes and analysis process for evaluation[30].

The context of community resilience is temporal to place and population. The Rockefeller Foundation created the City Resilience Framework to reduce the disaster risk in cities and to identify functions of what makes a resilient city[31]. Whereas the Community and Regional Resilience Institute define community resilience as the capability to anticipate risk, limit impact, and bounce back rapidly through survival, adaptability, evolution, and growth in the face of turbulent change.”[32]. Both of these initiatives describe the importance of local governments playing an instrumental role in building resilience through robust risk governance structures to ensure that impacts are mitigated, and measures are taken at the most localised and disaggregated level.

In a systematic review of definitions of community resilience related to disasters conducted by Patel et al found no evidence of a common, agreed definition of community resilience. However, nine characteristics were identified that were consistently used to describe community resilience. The core elements were: local knowledge, community networks and relationships, communication, health, governance and leadership, resources, economic investment, preparedness, and mental outlook[33]. Their results found 80 definitions of community resilience contextual to disasters in grey and peer reviewed literature that were broadly categorised as process (change and adaptation), absence of adverse effect (absorption, mitigation, prevention), and attributes (and response-capabilities)[33]. Patel appropriately identified that inconsistent definitions can result in variance in how community resilience is measured, creating heterogeneity if outcomes are compared[33]. Further to this Patel notes that whilst calls for a ‘*culture of disaster resilience*’ have been raised that without a shared understanding and meaning of community resilience such a culture cannot be described[33].

A gap in understanding related to community resilience is identification and measurement of vulnerable communities. Garlick reviewed efforts by the Victorian Government to address identification of vulnerability following recommendations of the 2009 Victorian Bushfires Royal Commission. In this review Garlick describes policy actions taken to reduce the commissions definition of vulnerability and thereby the scope of action required and consequently undertaken[34]. Whilst the author acknowledges that the initial scope as described by the commission was unmanageable, the actions subsequently taken demonstrate a lack in capacity to adequately address this complex issue. In particular the practice of shared responsibility, noted in the National Strategy for Disaster Resilience was reported missing in terms of sector and department collaboration. Vulnerability arises from social, cultural, health and environmental interactions; consequently no single agency is equipped to assume to adequately respond to identified needs[34]. These groups however

are inevitably best placed to assess their own needs and to plan how to meet them during and after emergencies.

This study explored community perceptions of disaster resilience using a Social Determinants of Health framework.

2.3.2 A National Strategy for Disaster Resilience

Increasing severity and regularity of disasters in Australia, and improvements required to enable and enhance coordinated effort across sectors to develop Australian disaster risk reduction capability were key drivers for the creation of The Australian National Strategy for Disaster Resilience[9].

The National Strategy for Disaster Resilience was developed to guide activity focussed on increasing disaster resilience. To achieve this the strategy articulated a risk management approach for emergency management planning across government and communities that considers the social, built, economic and natural environments[9]. The inter-sectorial approach within the strategy highlights the shared responsibility across government, business and communities to reduce risks related to natural hazards; and outlines prevention preparation and response guidance and supportive community practice to recover from disasters[9]. This was a philosophical shift in approach to hazard and disaster policy in Australia to create greater focus on prevention and preparedness. The development of the National Strategy for Disaster Resilience was driven from continued, sustained impact of disasters across Australia. In recognition of the changes in society and increasing urbanisation, new dependencies on technology, and a natural hazard profile that can disrupt and damage the development and improvement to Australian quality of life. In particular the National Strategy for Disaster Resilience recognises the shared responsibility across individuals, communities, business and Local, State and National Government in activities that prevent, mitigate, prepare for, respond to and recover from disasters[9]. This policy stance identifies that action and reliance sit not only with government and the emergency management sector, and in many cases sit well outside of them. The breath of inclusion in this strategic approach enables better measurement and understanding of risk in all of its domains and context and shares responsibility for controlling them.

The Australian National Strategy for Disaster Resilience was endorsed by the Council of Australian Governments (COAG) in February 2011. It comprises seven strategic priorities for action, and priority outcomes to guide federal, state, territory and local governments, business and community on disaster management[9]. These priorities are:

- Priority one: leading change and coordinating effort
- Priority two: understanding risks
- Priority three: communicating with and educating people about risks
- Priority four: partnering with those who effect change
- Priority five: empowering individuals and communities to exercise choice and take responsibility
- Priority six: reducing risks in the built environment

- Priority seven: supporting capabilities for disaster resilience[9]

In 2011, the Australian Government funded the Monash University Disaster Resilience Initiative to undertake a comprehensive and holistic thematic analysis of a selection of recent Australian disaster inquiries and reviews in the context of the National Strategy for Disaster Resilience. The review concluded that the Strategy provides a contemporary framework for disaster resilience and is consistent with international trends[35].

2.3.3 Disaster Risk, Risk Reduction and Mitigation

The health effects of natural disasters are well documented; from the initial impact, trauma and injury of the event to long term physical and psychosocial impacts that can extend from months to years[36, 37]. Robust public health and primary care planning that foresees increased risk and plans appropriately through activities such as public education and early surveillance for emerging health conditions will be more readily equipped to meet future challenges and reduce mortality and morbidity during times of disaster[38]. International research now suggests that health consequences of disasters have been reduced not only by improved immediate response and health management, but also by a more proactive health involvement and activity in all phases of Disasters[3]. Findings of the report '*The Human cost of natural disasters 2015*' also advocated for increased action on underlying drivers of disaster risk such as poverty which augment the negative impacts of disasters to enhance mitigation of such events[27]. Specific findings of population growth and patterns of economic development were noted to be of greater influence than climate change or cyclical variation in weather related to increasing disaster risk[27]. To enhance risk reduction disaster risk governance should be incorporated and integrated into planning, infrastructure, livelihoods, and broader economic and social development strategies.

The use of health standards in disaster risk reduction can contribute to producing interventions that build community strength, thereby enhancing mechanisms of coping and resilience when faced with adversity. The evolution and emphasis for disaster mitigation in Australia has been primarily and economically driven. The Australian Productivity Commission report on value related to cost saving from investment in emergency preparedness and prevention vs disaster response and recovery resulted in the creation of the National Disaster Resilience Taskforce and subsequent National Strategy for Disaster Resilience[39, 40].

2.3.4 The Sendai Framework for Disaster Risk Reduction

The Sendai World Conference on Disaster Risk Reduction stemmed from an evolution of disaster risk reduction work over the last 40 years. Disaster risk reduction is a rapidly growing area of practice that has a relatively short history. The impact of large-scale natural disaster in the 1970s led to the creation of the United Nations Disaster Relief Office. Subsequent recognition of the importance of disaster preparedness, risk reduction, and the need for improvement in coordination and action in response to disasters resulted in the International Decade for Natural Disaster Reduction (1990-2000) as declared by the United Nations.

During this decade the Yokohama strategy and Plan for action for a safer world was formulated at the first World Conference on Disaster Risk Reduction held in Yokohama, Japan, 1994. This conference and resultant strategy established the global imperative and responsibility in addressing the increasing frequency and impact of disasters internationally and provided guidelines for natural disaster prevention, preparedness and mitigation.

The end of the International Decade for Natural Disaster Reduction culminated in the Geneva Mandate on Disaster Reduction and the International Strategy for Disaster Reduction. The lessons and experience gained throughout the decade for Natural Disaster reduction built upon the principles of the Yokohama strategy and sought to develop improved efforts in prevention and mitigation.

The results of the Yokohama strategy were reviewed and presented in 2005 at the 2nd World Conference on Disaster Reduction led by the United Nations in Kobe, Japan. This conference took on particular poignancy coming almost 10 years post the Great Hanshin earthquake in Kobe and less than a month after the 2004 Indian Ocean earthquake and resulting tsunami. The global impact of these events and subsequent international response resulted in increased attention at the conference.

The objectives of the conference were to review the effect and outputs of the Yokohama Strategy, develop a plan for the following decade to frame the future Hyogo Framework for action, and find ways to reduce the impact of disasters through preparation. This included:

- pledges to reduce disaster damage
- healthcare after disaster
- early warning systems
- safe building standards
- agree upon cost-effective preventative countermeasures
- a global database on relief and reconstruction and a centre on water hazards

The lasting effect that this conference had was the development of the Hyogo Framework for action 2005-2015; endorsed by the UN General Assembly. The aim of the Hyogo framework was *'to substantially reduce the loss of life as well as the social, economic and environmental losses caused to communities and nations as a result of disasters'*. [3]

Underpinning this aim were three strategic goals and five priorities for action:

Strategic Goal 1: Integrating disaster risk reduction into sustainable development policies and planning,

Strategic Goal 2: Developing and strengthening institutions, mechanisms and capacities to build resilience to hazards,

Strategic Goal 3: Incorporation of risk reduction approaches into emergency preparedness, response, and recovery programmes.

Priority Action 1: Ensure that disaster risk reduction is a national and a local priority with a strong institutional basis for implementation.

Priority Action 2: Identify, assess and monitor disaster risks and enhance early warning

Priority Action 3: Use knowledge, innovation and education to build a culture of safety and resilience at all levels.

Priority Action 4: Reduce the underlying risk factors.

Priority Action 5: Strengthen disaster preparedness for effective response at all levels. [3]

The goal of the Framework was to develop the resilience of nations through inter-sectorial action and through this significantly reduce the impact of disasters over the following decade.

In March 2015 Sendai Japan, hosted the UNSIDR conference for disaster risk reduction. The program of presentations over 4 days contained no less than 10 separate sessions devoted to emerging risk, constituting 5 hours of working presentations and committing nearly 20% of conference time to examination of this single topic. Topic areas included:

- Rural resilience
- Lessons from Mega disasters
- Global Risk trends
- Water Resource management
- Ecosystem management and resilience
- Disaster Risk and Poverty
- Epidemic and Pandemic risk
- Economic risks of disaster risk reduction
- Land use planning and disaster risk reduction
- Disaster and Climate risk

This array of sessions provided a broad cross section of new and potentially evolving threats. Inclusive of this, the Global Risk Trend presentation that sought to analyse the current disaster risk environment. Interestingly this report identified that the disaster risk environment is increasing, and that many countries 'have understood and practiced disaster risk reduction as disaster management'. The output of these efforts is an improvement in response capacity, but minimal impact on risk mitigation or management. Furthermore, descriptors of risk areas within the report (poverty, employment, and environment) display strong correlation with contemporary determinants of health.

The intent of the Sendai Framework for Disaster Risk Reduction is to prevent new and reduce existing disaster risks through the implementation of integrated and inclusive economic, structural, legal, social, health, cultural, educational, environmental, technological, political and institutional measures that prevent and reduce hazard exposure

and vulnerability to disaster, increase preparedness for response and recovery, and thus strengthen the resilience[26]. The main features of the Sendai Framework include shifting focus from managing disasters to managing risks. This requires a better understanding of risk in all its dimensions of vulnerability, exposure and hazards.

The Seven Global Targets of the Sendai Framework to Achieve by 2030 are:

Substantially reduce:

1. Disaster mortality
2. The number of affected people
3. Direct disaster economic loss in relation to global gross domestic product (GDP).
4. Disaster damage to critical infrastructure and disruption of basic services, including health facilities

Substantially increase:

1. The number of countries with national and local disaster risk reduction strategies by 2020.
2. International cooperation to developing countries to complement their national actions for implementation of this framework.
3. The availability of, and access to, multi-hazard early warning systems and disaster risk information and assessments to the people[26].

These targets are diagrammatically represented in figure 1.

Figure 1: Seven Targets to achieve by 2030



[26]

The outcome indicators described by the Sendai Framework for Disaster Risk Reduction are reportable by member states on a biennial basis. Specific actions implemented by member states are published by UNDRR[26].

Whilst this progress is important in the context of identifying and improving disaster risk, risk and cause are not synonymous. The Global Risks Report provides a focused attention on the evolution of global risks and their interconnections. It is developed from the outputs of the Global Risks Perception Survey which is informed by the perspectives of leadership from various age groups, countries, and sectors. The Global Risk Report provides an updated analysis of risk and factors impacting risk variance. There is opportunity to complement these efforts through further examination of current and emergent disaster cause and threat. Contextualising threat analysis against risk analysis can assist in appropriate investment for planning and prevention strategies[41].

2.3.5 The Australian National Disaster Risk Reduction Framework

The Australian National Disaster Risk Reduction Framework (NDRRF) is designed to guide Australian disaster risk reduction aligned to the Sendai Framework and the Sustainable Development Goals. The goals of the NDRRF are to take action to reduce existing disaster risk, minimise creation of future disaster risk through decisions taken across all sectors, equip decision-makers with the capabilities and information they need to reduce disaster risk and manage residual risk. It describes strategies for action to meet these from 2019 to 2023 and identifies four national priorities to guide action that reduces disaster risk, these are:

- Priority 1: Understand disaster risk
- Priority 2: Accountable decisions
- Priority 3: Enhanced investment
- Priority 4: Governance, ownership and responsibility[42]

The National Disaster Risk Reduction Framework has noted as a principle that ‘the emergency management sector must engage collaboratively with players in other sectors, including but not limited to social welfare, environment, land use planning, health and infrastructure,...’; and that ‘there is a clear need for the emergency management sector to engage with and influence a broader set of policy levers in other parts of government, including climate change policies, land use planning policies, building codes and development standards to contribute to disaster risk reduction’[42].

Achievement of the framework is designed to enable Australian communities make disaster risk-informed decisions, be accountable for reducing risks within their control, and invest in reducing disaster risk in order to limit the cost of disasters when they occur.

Vulnerability to disasters is not a solely due to environmental and geographical factors. Social Determinants of Health including education, social isolation, and wealth all contribute to an individual’s and communities’ capacity and resilience. Furthermore, action within this social dimension can influence levels of vulnerability, from planning codes in cities and towns to environmental protection.

2.3.6 Social Determinants of Health

The Social Determinants of Health are defined as “the conditions in which people are born, grow, live, work and age, including the health system”[43]. As such when these

determinants are not distributed equitably, poor health is a consequence. The differences in health status observed between populations are a result of uneven distribution of wealth, power and/or policy that influence these determinants[44].

Social Determinants of Health, The Solid Facts, by Richard Wilkinson and Michael Marmot is a landmark paper that provides a conceptual framework in describing what it is to be healthy. This paper identifies that behavioural factors and structural issues are the two focus areas for the development of policy that can influence outcome[43].

The Commission on Social Determinants of Health (CSDH) was established by WHO in March 2005 to support countries and global health partners in addressing the social factors leading to ill health and health inequities. The Commission aimed to draw the attention of governments and society to the Social Determinants of Health and in creating better social conditions for health, particularly among the most vulnerable people. The Commission delivered its report to the World Health Organisation in July 2008 and subsequently ended its function. The three overarching recommendations to reduce health inequalities from the 2008 WHO report 'Closing the gap in a generation' on the Social Determinants of Health are: Improve daily living conditions; Tackle the inequitable distribution of power, money, and resources; and, Measure and understand the problem of health inequity, and assess the impact of action[44].

Further to these 3 overarching recommendations are ten elements used to describe The Social Determinants of Health:

1. The social gradient
2. Stress
3. Early life experience
4. Social exclusion
5. Work
6. Unemployment
7. Social support
8. Addiction
9. Food
10. Transport [43]

The Rio Political Declaration of 2011 confirmed Member State commitment to take action to address the Social Determinants of Health in five areas:

- Adopt improved governance for health and development,
- promote participation in policymaking and implementation,
- further reorient the health sector towards promoting health and reducing health inequities,

- strengthen global governance and collaboration,
- monitor progress and increase accountability[45].

The effects of disasters disproportionately affect vulnerable groups within communities[20]. Marginalised populations due to gender, age, disability, ethnicity, religion or sexual orientation are at greater risk to the impact of a disaster[21]. The concept of examining the causal factors of health and addressing them resonates well with contemporary disaster risk reduction practice. Whilst disaster practice to date has predominantly focussed on emergency management, new thinking proposes that investment in reduction, addressing vulnerability and improving community capacity provides a greater return on investment[20].

2.3.7 Sustainable Development Goals

The precursor of the Sustainable Development Goals was the Millennium Development Goals. Millennium Development Goals were eight international development goals established following the Millennium Summit of the United Nations in 2000, following the adoption of the United Nations Millennium Declaration. All United Nations member states and at least 23 international organizations committed to help achieve the Millennium Development Goals by 2015, these were: eradicate extreme poverty and hunger, achieve universal primary education, promote gender equality and empower women, reduce child mortality by two thirds for children under five, improve maternal health, combat HIV and AIDS, malaria and other diseases, ensure environmental sustainability and develop a global partnership for development. The Sustainable Development Goals are the successor to the Millennium Development Goals and seek to address global challenges of poverty, inequality, climate, environmental degradation, prosperity, and peace and justice. The evolution of the Sustainable Development Goals and the 2030 Agenda for Sustainable Development intersects and interconnects with the Sendai Framework for Disaster Risk Reduction and the Intergovernmental Report on Climate Change[46-48]. This collaborative approach is cognisant of the complementary nature of shared purpose and action in improving and protecting human and planetary health. Within the sustainable development field the Rockefeller sustainable cities project has coined the term ‘acute and chronic stressors’ and listed a number of ‘stressors’ associated with planetary health[49].

Reduction of disaster risks is a foundation for successful sustainable development, the Sendai Framework for Disaster Risk Reduction and its predecessor the Hyogo Framework for Action include the integration of disaster risk considerations into sustainable development processes as a key strategy[26, 50]. The linkage between sustainable development and disaster risk reduction is important to recognise as the impact of disasters can set back gains in sustainable development. Likewise unsustainable development practices increase risk to communities and infrastructure and appropriate, effective disaster risk reduction activities support developmental and reduce vulnerability.

The World Summit on Sustainable Development (WSSD), in Johannesburg, South Africa, in August-September 2002 provided the UNISDR with a concrete set of objectives within the sustainable development agenda to which both the Inter-Agency Task Force on Disaster

Reduction and the UNISDR secretariat, along with partners, will increasingly turn their attention and capacities to integrating and mainstreaming risk reduction into development policies and processes.

The Sustainable Development Agenda, adopted by the United Nations in 2015 is the framework to guide global peace and prosperity. The Sustainable Development Goals, successor to the Millennium Development Goals, are 17 initiatives to achieve the outcomes of the Sustainable Development Agenda[51]. Key Sustainable development goal indicators directly related to disaster risk reduction include:

Goal 1 No Poverty:

- Indicator: 1.5 Resilience to disasters,

Goal 11 Sustainable cities and communities:

- Indicator: 11.5 Resilience to disasters,
- Indicator: 11b Disaster risk management policies,

The Economic and Social Commission for Asia and the Pacific (ESCAP) serves as the United Nations' regional focal point for countries within that region in achieving the sustainable development goals. A key output produced by ESCAP is 'The Asia and the Pacific Sustainable Development Goals Progress Report'.

The most recent report in 2020, measuring progress since 2020, shows that the Asia and the Pacific at its current rate of action is unlikely to achieve the 17 Sustainable Development Goals by 2030.

Goals which are showing positive trends include action on health and well-being, education, water and sanitation, and safe and just societies (Goals 3, 4, 6 and 16).

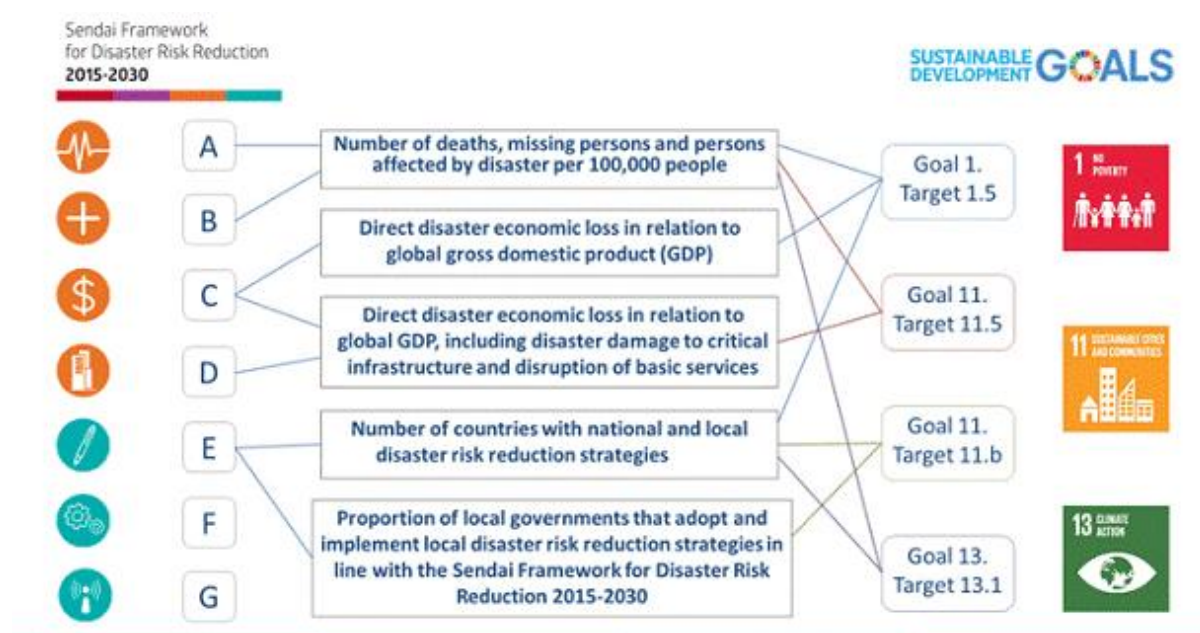
Key findings in the report demonstrate that inequalities, responsible consumption and production, achieving peace, justice and strong institutions are not progressing evenly across Asia and the Pacific. Indicators for goals related to gender equality, sustainable cities and communities, the environment are currently trending towards worse outcomes in 2030 than when previously measured in 2015. Intersection between disaster risk reduction and sustainable development in the region (Goal 12 and 13) shows that an increase its resilience against and capacity to reduce the risk of natural disasters and adapt to the adverse impacts of climate change through integrated policies is needed to protect communities and populations.

Countries within the Pacific when examined in isolation from Asia shows some difference in progress on SDGs. Whilst gender equality (Goal 5), sustainable cities and communities (Goal 11) and partnership for the goals (Goal 17), health and well-being (Goal 3), industry, innovation and infrastructure (Goal 9) and responsible consumption and production (Goal 12) has been reported as progressing; quality education (Goal 4), climate action (Goal 13) and life on land and below water (Goals 14 and 15) is lagging in comparison to regional peers. In particular the Pacific lags behind other subregions on climate action (Goal 13) measured by emissions and the impact of disasters [52].

2.3.8 International Consensus Frameworks

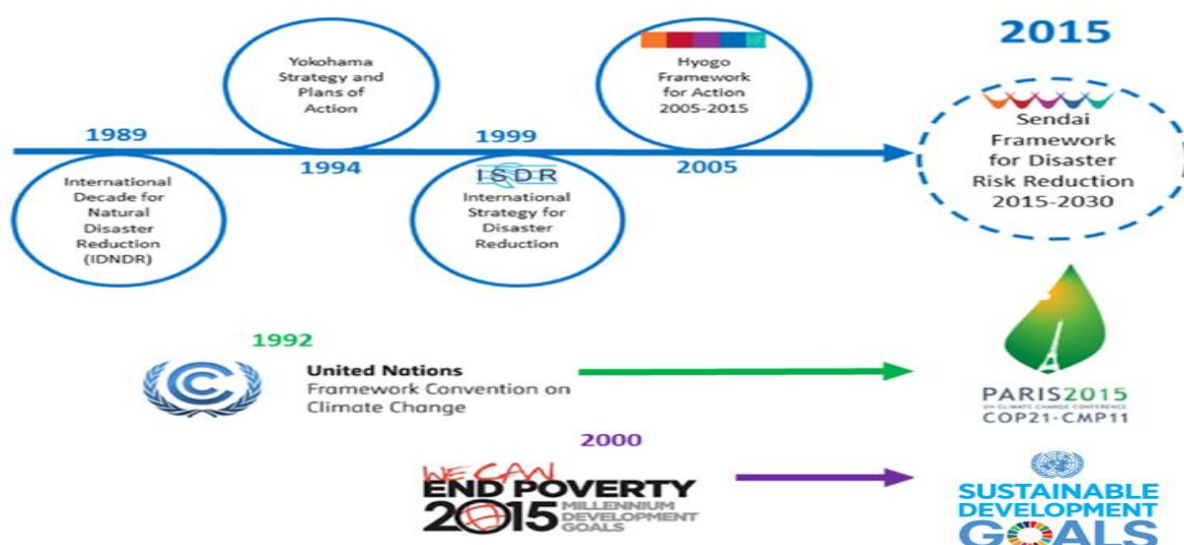
International Consensus Frameworks for improving the health status of populations overlap in a multitude of areas[53, 54]. Murray et al has provided in-depth analysis of these frameworks noting the intersectoral nature of activities that seek to protect and improve population health status[47]. The reduction of disaster risk is closely intertwined with the fields of sustainable development, health, environmental protection, climate change and human migration. A multi-sectoral approach will be required to strengthen disaster risk reduction in key areas. Development and resilience programs are unlikely to be sustainable unless disaster risk is understood and addressed. To achieve this risk assessment across sectors will require comparable methodologies to enable evidence-based decision making to realise improvements. Comparison and relationship between key international policy sectors, notably the Sustainable Development Goals and The Sendai Framework for Disaster Risk Reduction has been published and is shown in table 1[55]. The temporal introduction of these key international global consensus frameworks including climate change is shown in figure 2[54]. These relationships can be further enhanced by the addition of the Social Determinants of Health to show the linkage, and equally important, the gaps between frameworks for development, disaster risk reduction and health determinants (table 2).

Table 1: The Sustainable Development Goals and The Sendai Framework for Disaster Risk Reduction



[55]

Figure 2: Temporal introduction of key International Consensus Frameworks



[54]

Table 2: Intersection and linkage of the Social Determinants of Health, the Sustainable Development Goals and The Sendai Framework for Disaster Risk Reduction 2015-2030

Social Determinants of Health	Sustainable Development Goals	The Sendai Framework for Disaster Risk Reduction 2015-2030
the social gradient	Goal 1: Eradicate extreme poverty and hunger Goal 3: Promote gender equality and empower women	Number of countries that adopt and implement national disaster risk reduction strategies in line with the Sendai Framework for Disaster Risk Reduction 2015-2030. Number of deaths, missing persons and persons affected by disaster per 100,00 people Direct economic loss in relation to global GDP, damage to critical infrastructure, and number of disruptions to basic services, attributed to disasters
stress	<i>No direct comparator</i>	<i>No direct comparator</i>

early life	Goal 2: Achieve universal primary education Goal 4: Reduce child mortality rates,	Number of deaths, missing persons and persons affected by disaster per 100,00 people
social exclusion	Goal 3: Promote gender equality and empower women	<i>No direct comparator</i>
work	<i>No direct comparator</i>	Direct disaster economic loss in relation to global gross domestic product (GDP)
unemployment	Goal 1: Eradicate extreme poverty and hunger	Direct disaster economic loss in relation to global gross domestic product (GDP)
social support	Goal 1: Eradicate extreme poverty and hunger Goal 3: Promote gender equality and empower women	Number of countries that adopt and implement national disaster risk reduction strategies in line with the Sendai Framework for Disaster Risk Reduction 2015-2030. Direct disaster economic loss in relation to global gross domestic product (GDP) Direct economic loss in relation to global GDP, damage to critical infrastructure, and number of disruptions to basic services, attributed to disasters
addiction	<i>No direct comparator</i>	<i>No direct comparator</i>
	Goal 1: Eradicate extreme poverty and hunger	Direct economic loss in relation to global GDP, damage to critical infrastructure, and

food		number of disruptions to basic services, attributed to disasters
transport	<i>No direct comparator</i>	Direct economic loss in relation to global GDP, damage to critical infrastructure, and number of disruptions to basic services, attributed to disasters

This comparison demonstrates continuity in some areas, and no direct comparator in others. Analysis of linkages between the elements described in the Social Determinants of Health framework and disaster health practice provides opportunity to identify indicators that may assist in guiding risk reduction measures. Such examples include:

- That health is a determinant of disaster resilience (or vice versa); increased vulnerability to infection during a pandemic due to lower socio-economic status being an example of this.
- A demonstrated relationship between coronary disease and stress, access to health food and healthy life choices, and/or air quality; longitudinal indicators associated with disaster recovery could be examined.
- A number of disaster risk mapping tools according to impact indicators are now available for emergency management policy guidance and operational use. Alongside this, social workers are developing mapping instruments to identify vulnerable populations according to health and wellbeing indicators. If these instruments could be combined a potentially better sense of vulnerability could be assessed.

Application of practices such as these are congruent with contemporary guides for risk reduction including the HE-DRM Framework[6]. This approach is also consistent with the Sendai Framework which specifically identifies the need for health system resilience and disaster risk management for health: “Enhance the resilience of national health systems, including by integrating disaster risk management into primary, secondary and tertiary health care, especially at the local level; developing the capacity of health workers in understanding disaster risk and applying and implementing disaster risk reduction approaches in health work; promoting and enhancing the training capacities in the field of disaster medicine; and supporting and training community health groups in disaster risk reduction approaches in health programmes, in collaboration with other sectors, as well as in the implementation of the International Health Regulations (2005) of the World Health Organization.”[26]

2.4 CONCLUSION AND REVISED RESEARCH QUESTIONS

The National Strategy for Disaster Resilience recognises that disasters are increasing in their complexity and frequency[9]. Priorities of prevention and mitigation have been firmly embedded within this strategy to mitigate the effects of disasters upon the community. There is an opportunity for further engage public health practice with disaster management professions, recommendations based on the review of inquiries include:

- Given the increased focus of health within the Sendai Framework there is an opportunity for signatories to consider how this framework informs the structure of contemporary and future inquiries
- Application of a consistent and evidence-based process and methodology of inquiry practice to enable thematic review of lessons identified with a particular focus on:
 - How Public Health frameworks can potentially assist in identifying vulnerabilities that influence resilience and influence actions that strengthen communities.
 - What role disaster health practice achieves in shaping the social environment conducive to better health and,
 - How such interventions can assume wider responsibility for creating more healthy, resilient societies.

The aims of the study were to investigate how the Social Determinants of Health inform outcome indicators of disaster programs. Following consideration of the key concepts of the key literature and review of contemporary practice the revised research questions developed to address this aim were:

- What are the profiles of emerging disaster risks in Oceania?
- In what way do the Social Determinants of Health inform outcome indicators of disaster programs?
- How can disaster risk reduction interventions assume wider responsibility for creating healthy societies?

Chapter 2 provided a structured overview of the rationale for this project, a focussed analysis of literature concepts related to the research undertaken and synthesis of the research questions. Chapter 3 describes the conceptual framework that was developed to guide the research undertaken in project and the elements it is comprised of.

3 A CONCEPTUAL FRAMEWORK TO STRUCTURE THE RESEARCH

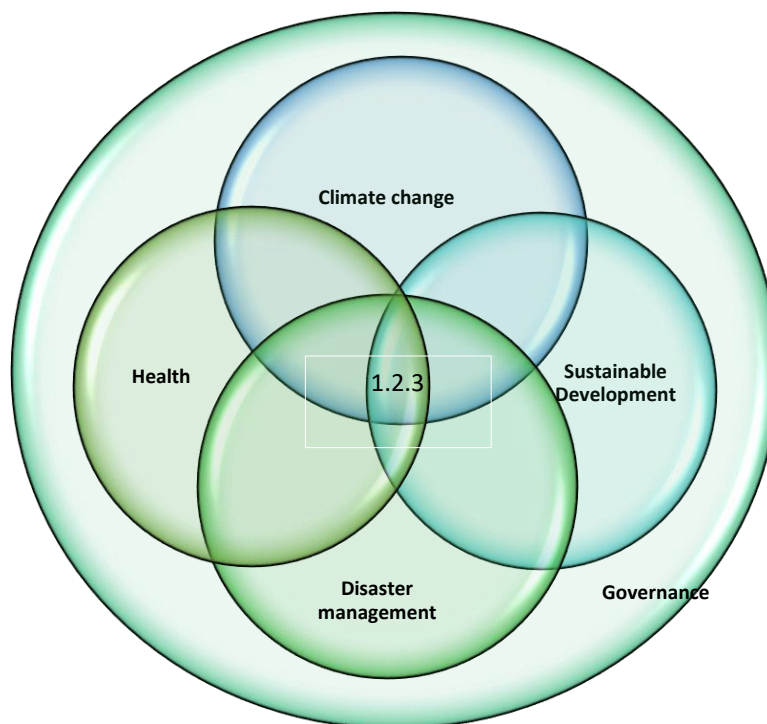
3.1 Introduction

Chapter 2 provided an overview of the rationale for this project and synthesis of the research questions. This chapter describes the conceptual framework that guided the research undertaken in this project.

3.2 Developing a conceptual framework

This Thesis applied “Emerging disaster risk”, “The Social Determinants of Health”, and “disaster risk reduction”, as its unifying themes. This research applied “health”, “climate change”, “sustainable development”, “disaster management”, and “governance” as its theoretical elements. The inter-sectorial relationship of these frameworks in relation to these themes can be described in the following diagram:

Figure 3: Conceptual framework



Key:

- 1: Emerging Disaster Risk
- 2: Social Determinants of Health
- 3: Disaster Risk Reduction

Emerging Disaster Risk

Disaster risk reduction ‘aims to prevent new and reduce existing disaster risk, strengthening the resilience of people, systems and approaches’ [25]. The practice of forecasting emerging risk, and identification of new or increasing disaster risk enables prospective disaster risk management activities. This practice is consistent with the Sendai Framework which states that to strengthen resilience, countries must prevent new and reduce existing disaster risk [26]. However, in order to identify and mitigate emerging disaster risk, we need to understand the hazards communities face, and their exposure and vulnerability to them.

Social Determinants of Health

The social determinants of health are ‘the circumstances in which people grow, live, work, and age, and the systems put in place to deal with illness. The conditions in which people live and die are, in turn, shaped by political, social, and economic forces’ [43, 45]. The World Health Organisation (WHO), has described social inequalities and disadvantage as the main reason for avoidable and unfair differences in health outcomes and life expectancy [45, 56]. Wilkinson and Marmot reported that a person’s living and working conditions, their access to support and overall socioeconomic status influence and are related to their health and wellbeing [43].

Disaster Risk Reduction

Disaster risk reduction as defined by UNDRR ‘is aimed at preventing new and reducing existing disaster risk and managing residual risk, all of which contribute to strengthening resilience and therefore to the achievement of sustainable development’[25]. It is a holistic approach to long term community and state development that unifies preparation and mitigation practices. Its function has been described as ‘lying between the interface of humanitarian response to disasters and developmental programs’[57]. Yet it is more than this as the context of disaster risk reduction is broader than that of the developing country model and speaks equally to the long-term planning needs of developed countries. Disaster risk reduction is inclusive of practices of disaster management, disaster mitigation and disaster preparedness. Further to this disaster risk reduction contributes to the field of sustainable development, and likewise sustainable development contributes to disaster risk reduction.

Climate Change

The Intergovernmental Panel on Climate Change is a scientific body under the auspices of the United Nations. It reviews and assesses the most recent scientific, technical and socio-economic information produced worldwide relevant to the understanding of climate change and is the leading international body for the assessment of climate change. The United Nations General Assembly has encouraged the Intergovernmental Panel on Climate Change to continue to assess the adverse effects of climate change upon communities and recognises the need for implementation of disaster risk reduction programs[58]

The intent of the Fifth Assessment Report produced by the Intergovernmental Panel on Climate Change is to provide an updated view of scientific knowledge relevant to climate

change. Within this report specific focus is given to managing the risks of extreme events and disasters to advance climate change adaptation[59].

Three impact categories in particular are identified by the report:

- reduced food yields due to drought
- increased morbidity and mortality due to extreme heat waves, fire and extreme weather events and
- Changes in infectious disease spread and duration due to alterations in weather and vector distribution.

There is unclear evidence of attributable illness and injury rates related to climate change comparative to known, major burdens of disease and poor health (i.e. smoking, poverty)[38]. The Intergovernmental Panel on Climate Change however has reported consensus on emerging risks associated with climate change; as such it represents a non-traditional, emerging threat to the health status of communities.

Emergency management practice within the Australia has made progress in identifying climate change as future hazard[60]. The Australian Prime Minister's National Security Statement of 2008 identified Climate change as representing 'a most fundamental national security challenge for the long term future.'[61]. As a consequence, the review and update of key disaster resilience policy documents at a National level has included climate change within their frameworks[9].

Disaster Management

The evolution of disaster practice has been one that began with the model of PPRR (prevention, preparation, response, recovery) to that of disaster risk mitigation and capacity building[4, 62].

The application of this has occurred primarily in humanitarian practice, in 2003 the 28th International conference of the Red Cross and Red Crescent produced the Agenda for Humanitarian Action to 'reduce the risk and impact of disasters and improve preparedness and response mechanisms'[63]. This learning is now establishing itself in emergency management systems in developed countries. The Victorian Emergency management reform white paper identified the need for stronger risk and resilience practices within the emergency management sector[64]. This State initiative is underpinned by the intent of the National Strategy for Disaster Resilience[9].

Health

The Sendai Framework and its predecessor The Hyogo Framework for action identify health as a priority for action and contributor to strategic disaster risk reduction. Specifically, that disaster risk reduction is integrated into the health sector and safe hospitals[58].

Health, as defined by the World Health Organization (WHO), is the "complete state of physical, mental and social well-being"[65]. This definition identifies that health is not simply the absence of disease but the composition of multiple inputs to create a complete

state of well-being. The focus of contemporary medicine has been predominantly focused on physical diagnostic and treatment therapies. Invariably this treats the presenting problem, rather than the cause. Examination and research into the causal factors of wellbeing have revealed that associations within society and community can and do impact population health. This construct has been further developed and is widely known as the Social Determinants of Health.

Sustainable Development

Sustainable development has been defined as: "development that meets the needs of the present without compromising the ability of future generations to meet their own needs"[66]

The Johannesburg Plan of Implementation of the World Summit on Sustainable Development identified the need for 'an integrated, multi-hazard, inclusive approach to address vulnerability, risk, assessment and disaster management, including prevention, mitigation, preparedness, response and recovery, is an essential element of a safer world in the 21st century'[67].

The Millennium Declaration, which led to the development and implementation of the Millennium Development Goals, specifically focuses upon disasters, resilience and vulnerability. Section 4, item 23 of the Millennium Declaration included the recommendation 'to intensify cooperation to reduce the number and effects of natural and man-made disaster'[68]. Furthermore section 6 item 26 states 'We will spare no effort to ensure that children and all civilian populations that suffer disproportionately the consequences of natural disasters, genocide, armed conflicts and other humanitarian emergencies are given every assistance and protection so that they can resume normal life as soon as possible.'[68].

Governance

The challenge required to achieve action in all these areas are great as it requires long term political vision and will to enable policy and planning that increases security at an individual, community and national level. Furthermore, if implemented these practices must be people centred. The provision of guidance, information, and access to services that incorporate and build on social norms and cultural practices will improve program integration and enable informed decision making by citizens.

3.2.1 Assumptions and inclusions

This research project was designed based on several assumptions and inclusions. The research supervisory team was assumed to have required availability to contribute to the project. In the first half of the project a research supervisor suddenly, and unexpectedly passed away. During the internship at CRED, I was fortunate to develop an international network of academics practising in disaster health research. A supervisor was identified from this network who graciously accepted inclusion as a research supervisor and has provided key guidance on the development and publication of multiple papers related to the research project.

All participants (including the PhD candidate) were challenged by the emergence of SARS COVID-19 and the subsequent global pandemic. Given that all participants are intricately involved in disaster health practice and management in full time capacities its was notable the contributions, guidance and assistance was achieved during the span of this project with this disruption. Further to this the participants skills, knowledge and experience as academics and leaders at an international level was an assumption in the selection process

Inclusion criteria are defined as the key features of the populations examined to answer the research question [69]. Inclusion criteria for this project included demographic, social, and geographic characteristics of the Oceania region and the population of Dwellingup Western Australian. It is important to note that outcomes consequently are reflective of the areas investigated when considering comparisons to other populations or regions [70].

3.3 SUMMARY

The conceptual framework described guided the research undertaken in this project. The following chapter outlines the key elements of the research design and steps undertaken.

4 OVERVIEW OF RESEARCH DESIGN USED IN THIS RESEARCH

4.1 INTRODUCTION

This project used mixed methods of qualitative and quantitative inquiry to explore and analyse emerging disaster risk and the relationship of health determinants and disaster risk reduction. Research design was informed through identification of knowledge gaps related to the project theme.

4.2 KEY ELEMENTS OF THE RESEARCH DESIGN

Key elements of the research process were developing research tools, data collection, data analysis, and establishing ethical approval and governance. Further detail on these elements is described in methodology outlined in Stages 1 and 2 and chapters 5 and 6 respectively.

4.3 DEVELOPING RESEARCH TOOLS

4.3.1 Practitioner based interviews - locations and participant sampling

Using convenience sampling, thirty-five interviews, contacted by email or face-to-face, were requested. Of these, 30 accepted to be interviewed while the remaining 5 did not respond to the email request. All of the participants were engaged in disaster management in the Oceania region as researchers, practitioners in emergency management or disaster healthcare, policy managers or academics and were identified through existing disaster management professional networks within the region. Thirty individual interviews with participants from 9 different countries were conducted face to face (n = 19) or by telephone call (n = 11).

4.3.2 Community based fieldwork – sites and participant sampling

Using purposive sampling thirty-three face-to-face interviews were requested of the local community via a local emergency management member. Of these, eighteen accepted to be interviewed while the remaining fifteen did not respond to the email request. No potential interviewees refused to participate once they accepted. Participants were selected using purposive sampling in the sense that were chosen based on experience as a community member in connection to local disaster risk management. This community was accessible during the COVID-19 Pandemic and enabled continuation of the research during National and International restricted movement and impact. Data collection was conducted between March 2018 to May 2019, and a typical interview lasted between 45 – 60 minutes. Interviews were ceased when responses indicated no new information was obtained.

4.4 DATA COLLECTION

4.4.1 Participant engagement

Participant engagement for the first research project was facilitated via a personal network of researchers, practitioners and managers developed through engaging in disaster and humanitarian care over the last two decades. This network was instrumental in being able to achieve insights and information relative to the research questions associated with the first research project.

Participant engagement in the second research project was facilitated via a local personal network developed via working as a Paramedic for over twenty years in Western Australia. My role as a Paramedic was an enabler of community trust that assisted in engaging the opinions of community members who informed the outcomes of research project two.

4.4.2 Semi-structured interviews

Qualitative information for both projects was gathered by semi structured interviews. These interviews were guided by predeveloped question lists to guide interviews whilst allowing participants to explore ideas and provide unique insights related to the research aim and objectives.

4.5 DATA ANALYSIS

This project used mixed methods to collect and analyse data that informed the research outcomes. Where quantitative data was collected data analysis was guided by the data type and question asked. Disaster event cases were tabulated to show volume over time, where Likert scales were used totals were calculated and averaged. Qualitative data analysis was conducted using the methodology described by Braun et al[71].

4.6 ETHICAL AND GOVERNANCE CONSIDERATIONS

All respondents participating in research associated with this project provided written informed consent prior to participation and did not receive any incentives to participate in the study. Ethical approval was requested and obtained from Monash University Ethics Committee (HREC 7539). Recordings were stored safely and kept confidential as per The Australian Code for the Responsible Conduct of Research[72].

4.7 CONCLUSION

The research projects undertaken in this PhD were informed by a literature review that identified gaps in knowledge related to disaster measurement and the relationships of health determinants and disaster risk. Exploration of these gaps was undertaken using mixed methods. This approach engaged community and practitioners to develop new

knowledge which was compared to existing data as shown in following chapters. The following chapter will describe Stage 1 of the research conducted in this PhD, Profiling Emerging Disaster Risk in Oceania.

5 STAGE 1 PROFILING EMERGING DISASTER RISK IN OCEANIA

5.1 INTRODUCTION

Traditional Emergency management-based frameworks employ hazard and risk analysis in the development of preparedness, response and recovery plans. This analysis is invariably based on historical data of event impact. The nature, scale and type of disasters are changing globally [12, 14]. The emergence of new disaster types, the re-emergence of former health risks and the development on non-traditional threats requires broader investigation of future disaster threats to population health. The previous chapter described the research methods and approach to the studies conducted in the project. This chapter contains studies conducted in the research project including the peer reviewed papers based the outputs including database analysis, emerging disaster risk in Oceania, climate change as a hazard and volcano risk in the Pacific.

5.2 STAGE 1 RESEARCH DESIGN AND METHODOLOGY

5.2.1 Rationale

The rationale for undertaking Stage 1 was to investigate emerging disaster risks to the health and wellbeing of societies associated with disaster impact. Emerging disaster risks are poorly understood. Without clear evidence, readiness to accept future threats is low resulting in delayed strategic planning for adaptation or response. The role of the analysis was to examine what emerging disaster risk evidence exists to support decision making and profile the nature, type and potential human and economic impact of emerging disaster risk.

5.2.2 Research questions and literature review

Traditional emergency management-based frameworks employ hazard and risk analysis in the development of preparedness, response and recovery plans. This analysis is invariably based on historical data of event impact. The nature, scale and type of disasters are changing globally [12, 14]. The emergence of new disaster types, the re-emergence of former health risks and the development on non-traditional threats require broader investigation of future disaster threats to population health.

Contemporary commentary of emerging disaster risk has identified several potential risk areas. These include, but are not limited to:

- Climate change
- Infectious disease/pandemic
- Large scale natural disaster
- Biodiversity crisis

- Terrorism and unconventional warfare
- Uncontrolled urbanisation
- Chronic fiscal imbalances, severe income disparities, water supply crises, and cyber-attacks[16]

The changing nature, scope and impact of future disasters present unique challenges across a range of sectors involved in disaster risk reduction practice. The opportunity to establish effective partnerships and cooperation existed in 2015 when the World Conference on Sustainable Development and the Third World Conference on Disaster Risk Reduction will both took place. UNDRR has recognised this and identified themes to guide expectations from these gatherings.

1. What is the core and nature of that which can and needs to be agreed at the 3rd World Conference on Disaster Risk Reduction through the specific means of a new international policy framework?
2. What are the essential characteristics and elements that the post-2015 framework for disaster risk reduction needs to have in order to support, if not ensure, the integration across development, climate change, environment and disaster risk reduction?[73]

Consultation on these themes has begun, in particular expected deliverables post 2015 include actions to foster accountability, enhance risk governance, address underlying causes of increase in disaster losses and risk, reduce vulnerability, enhance resource mobilization, enact policy, and establish monitoring and review processes.[73]

Achieving this will alter the current landscape of disaster risk reduction frameworks; elements will be added, enhanced, removed, or reduced. Likewise, implementation of future plans will also rely on expressed commitment from stakeholders and coordination of indicator monitoring between development and disaster risk reduction strategies.

In Peter Walkers keynote address to the 2009 Humanitarian Action Summit emphasised the complexity of contemporary and future crisis was noted[74]. This complexity is associated with increasing global connectedness at economic, environmental, resource and social levels. As a consequence, causal factors are various and interrelated. Of note the paucity of reliable data gathering systems was recognised, along with the resultant lack of capacity to reliably identify future risks[74].

Burkle[16] has proposed several key emerging disaster risk areas. These are biodiversity crisis, climate change, large scale natural disasters, emerging and re-emerging diseases, globalisation induced crisis, and land scarcity. This landmark paper exemplifies the challenges in synthesising the vast literature and reports available to provide clear guidance to policy makers and practitioners.

Stage 1 addressed the following research question: What are the profiles of emerging disaster risks in Oceania?

5.2.3 Design

The design for Stage 1 was a stepwise process of analysis of existing disaster data monitoring, capture and reporting from an international and national perspective. This was used to understand how disasters are classified and the current understanding of measured hazards and threats. This was followed by a project to explore emerging threats either captured or not captured by disaster databases.

5.2.4 Methodology

The methodology was conducted in two parts:

1. Stage 1 Quantitative data analysis. Data from the Centre for Research on the Epidemiology of Disasters examining historical and contemporary trends in global Disasters.
2. Stage 1 Qualitative data analysis. Thematic analysis using semi-structured telephone interviews via Skype, involving thirty international experts in disaster and emergency management was conducted. This utilised a theme list informed by the literature review. The interviews were, transcribed and a thematic analysis was undertaken.

5.3 STAGE 1 QUANTITATIVE DATA ANALYSIS

5.3.1 Introduction

The previous section described the design and methodology undertaken in stage 1. This section describes the quantitative data analysis undertaken.

5.3.2 The Centre for Research on the Epidemiology of Disasters, the Emergency Events Database, access and usage

The Centre for Research on the Epidemiology of Disasters (CRED) maintains an up-to-date database of worldwide disasters with which it conducts research, training and information analysis on disaster events. A major focus of their work is public health, epidemiology and social economic aspects of disasters. CRED data is sourced from external sites and sources and is cross referenced for validity and accuracy. By providing accurate, up to date information they aim to enhance the effectiveness of disaster risk management and mitigation currently conducted by developing countries.

The CRED criteria for disaster entry into their database (EM-DAT) is:

- 10 or more people reported killed
- 100 people reported affected
- a call for international assistance, or
- a declaration of a state of emergency[75]

EM-DAT Data is presented as top 10, summarized table and raw data. This data is then further defined in categories such as deaths caused or number affected[75].

Oceania is a geographical region consisting of numerous countries most of which are islands in the Pacific Ocean and vicinity. The islands of Oceania are divided into the subregions of Melanesia, Micronesia, and Polynesia. Australia's proximity to the countries of Oceania is of importance in considering disaster event trends; however, Australia's profile does differ from these regions due to its size as a continent that extends from equatorial tropics to southern, temperate areas.

Disasters can be of natural or technological causes and the supporting infrastructure and economic status of a country can influence the extent of damage and effect. Natural disasters have had the greatest effects on both Australia and Oceania. The total amount reported in economic damage by natural disasters for Australia between 1991 and 2005 is over 13 billion dollars[75]. To date the largest single disaster recorded is that of extreme temperature affecting over 3 million people in February 1993[75]. Drought has had the greatest overall impact on the Australian people where 10 events have resulted in 44% of reported deaths, over 7 million people have been affected and economic damage has exceeded 15 million dollars[75]. Windstorms have been most prevalent with 90 events recorded and have accounted for the most injuries at 988[75]. The highest statistic for causing homelessness was wildfire at 19,181[75]. I believe this statistic is of important relevance when considering the psycho-social impact on individuals and communities and the long-term economic ramifications. These effects would be difficult to quantify, as such I believe the number does not truly represent the full consequence of being 'homeless' on the individual, society and community. It is wildfire that differentiates Australia disaster statistics to those of Oceania. In comparison to natural disaster statistics in Australia the highest statistic in relation to people affected by technological disasters is 2000, all as a consequence of an industrial accident in February 1990[75].

In Oceania there is some variance between subregions and statistics regarding Oceania are not as complete as those of Australia particularly in subregions involving Polynesia. Like Australia however windstorms are the most frequently occurring natural disaster event but drought over shadows all in terms of its effect on populations with over 900,000 people affected[75]. Major differences as previously mentioned include wildfire occurrence and Melanesia stands alone in terms of volcanic activity as a consequence of disaster with over 40% of geological events of disastrous outcome being attributed to them[75]. The highest single cause of death from disaster also differs, with the top cause in Oceania being windstorm. Variance in population statistics (deaths/ number affected etc) may be due not only to geographical differences but also to geo-political and economic status of the communities (i.e., high urban density in disaster risk areas with poor infrastructure, internal conflict, etc).

Due to our geological placement, we share trends in disaster occurrence with our neighbours. Identifying disaster variance and drivers associated with them can improve regional knowledge and understanding of risk assessment and hazard management to decrease the impact these events have on our respective populations.

5.3.3 Hazard and Peril Glossary

The Integrated Research on Disaster Risk programme established a project to investigate “study issues related to the collection, storage, and dissemination of disaster loss data” [76]. This project resulted in the development and production of the Peril Classification and Hazard Glossary [76]. This glossary provides standardised hazard terminology, event classification, and a unified terminology for operating loss databases.

The Sendai Framework for Disaster Risk Reduction expanded the scope of disaster risk hazards. According to the open-ended intergovernmental expert working group on indicators and terminology relating to disaster risk reduction adopted by the United Nations General Assembly in 2016; a hazard is defined as: “a process, phenomenon or human activity that may cause loss of life, injury or other health impacts, property damage, social and economic disruption or environmental degradation” [77]. This definition has led the future review of hazard classification undertaken by the United Nations Office for Disaster Risk Reduction and the International Science Council.

This glossary informed this thesis by providing a contemporary list of definitions applied in disaster. This list then informed how or if emerging or non-traditional disaster definitions are currently captured

5.3.4 Categorisation of Disasters

Many Governments, non-government and private industries collect and maintain disaster loss databases. Differences and lack of standardisation of definition and classification complicate comparisons of data. Application of consistent standards and definitions of data collection, and quality assurance of data collection ensures reliability and comparison of database findings. International classification of disasters is guided by the definitions of the Integrated Research on Disaster Risk Programme Peril classification and hazard glossary. The glossary provides guidelines for classification and hazard definitions used in many disaster loss databases such as EM-DAT, NatCatService, Sigma, DesInventar and SHELATUS[76].

Hazards are broadly categorised as natural or technological/ man made. Natural hazards are rapid or slow onset physical phenomena which can be geophysical (such as earthquakes and volcanoes), hydrological (such as flood), climatological (such as drought), meteorological (such as cyclone and storm) or biological (such as epidemic). Technological or man-made hazards are events caused by humans (such as industrial accidents, pollution and transport accidents)[76].

5.3.5 Emergencies of Scarcity, the International Union for Conservation of Nature Commission on Ecosystem Management Resilience Thematic Group

The International Union for Conservation of Nature (IUCN) mission is to "influence, encourage and assist societies throughout the world to conserve nature and to ensure that any use of natural resources is equitable and ecologically sustainable". The IUCN Commission on Ecosystem Management established the IUCN CEM Resilience Thematic Group to clarify resilience in respect to natural resource stewardship, disaster risk reduction and ecosystem-based adaptation. The mission of the Resilience Thematic Group is to strengthen the application of the concept of “resilience in complex adaptive social-

ecological systems” by IUCN programmes, commissions, and members, and the people and communities with whom they work. Activities include the publishing of materials related to the organisation actions, including blogs. An opportunity to contribute to the Resilience Thematic Group arose during the course of my PhD journey to provide input into emerging disaster risk related to IUCN mission and goals. The focus of this blog was freshwater scarcity as an emerging disaster risk, published 2018 accessible by the following link and extracted below

Emergencies of Scarcity and fresh water [78]

Disaster classifications traditionally limit water scarcity emergencies to an outcome of drought. However, a lack of supply infrastructure, poor water usage technology, population changes that influence demand, and urbanisation rates all can also cause such an emergency. These forces threaten community and public health and well-being, and warrant rethinking how one classifies water scarcity emergencies[16, 79]. Such re-classification has implications for attaining Sustainable Development Goals, and resilience-building.

The threat of freshwater scarcity has been realised as recent crisis in major urban centres and has provided a reminder to communities of our vulnerability in an increasingly urbanised world. Sustainable Development Goal Six is the provision and access to water and sanitation for all, yet whilst there is sufficient fresh water on the planet, water scarcity and increasing water competition for rural and urban poor is a predicted risk for many people[80]. The recently released World Economic Forum’s 2017 Global Risks Report has forecasted a two-thirds decrease in fresh water availability by 2050, and predicts that the pressure upon this scarce resource will intensify due to a projected increase in global demand[41].

Unfortunately, freshwater scarcity in the Pacific is not a new problem. Small island states have reported decreasing access for the better part of the last decade, and in 2011 Tuvalu declared a state of emergency due to fresh water supply stress. A primary dependence upon rainfall and limited ground water supply, coupled with increasing urbanisation, has resulted in demand exceeding an already stressed supply. In parallel, a lack of fresh water and sanitation in Pacific Islands has resulted in upwards pressure on public health indicators such as infant mortality rate, which has soared to twice that of other South East Asian countries[81].

Climate change has exacerbated freshwater stress in Oceania by amplifying effects of sea level rise and drought. Rising sea levels, increasing frequency and intensity of tropical storms, and acidification of ocean water, are expected to make parts of Pacific Island nations uninhabitable. Greater-than-average sea level rise has already caused significant erosion and degraded habitable area in the Solomon Islands and Nautambu Island. Sea level rise also causes salt water to infiltrate the water table and ground water supplies, rendering them unusable for populations[82].

The linkage of disaster risk reduction, sustainable development and climate change policy has been previously identified[83]. At a community level, the use of nature-based solutions

to reduce disaster risk and mitigate disaster impact have been recommended as effective tools[84]. As new threats evolve that threaten the health status of communities, the application of resilience activities that mitigate their potential impact merits further exploration.

Achieving the primary target of Sustainable Development Goal Six – universal and equitable access to safe and affordable drinking water for all, and the safeguarding of water resources for future communities – requires a coordinated effort, global will, and community engagement. Fresh water scarcity constitutes an emerging threat to health, and disaster classifications should recognize its multiple sources, including but not limited to drought. This will facilitate the development of mitigation strategies that will promote resilience of populations to water scarcity.

5.3.6 Discussion on international disaster data recording

Accurate data reporting of the impacts of disasters is imperative to inform risk measurement and enable effective strategies for risk reduction. Public health information describes population health status, timely reporting of which shows trends that identify vulnerabilities and weaknesses that may influence resilience to the effects of disasters. The next chapter provides an overview of the process of how Australian disaster data is captured, measured, and reported nationally.

5.4 AUSTRALIAN DISASTER HUB

5.4.1 Disaster Mapper

The Disaster Mapper is an interactive open-source online database hosted by the Australian Disaster Resilience Knowledge Hub that provides information on historical Australian disasters[85]. The Australian Disaster Resilience Knowledge Hub notes that Disaster Mapper is not an exhaustive or definitive record.

The Australian Disaster Resilience Knowledge Hub is managed by the Australian Institute for Disaster Resilience on behalf of the Australian Government

5.5 IMPROVING DISASTER DATA SYSTEMS TO INFORM DISASTER RISK REDUCTION AND RESILIENCE BUILDING IN AUSTRALIA: A COMPARISON OF DATABASES

5.5.1 Introduction.

The study of disaster risk is primarily aimed at identifying who may be at risk (vulnerable populations) from specific events (causes) to prevent and/or facilitate timely responses to them. These causes are predominantly defined by historical data rather than from forecasting potential risks. This data is recorded in multiple data systems at a global and country level. Consistency in data definitions, capture and recording is essential to enable

comparative research and draw findings to inform practice. The aim of the following paper was to undertake a comparison of a global disaster database and an Australian National disaster database to identify strengths and opportunities for improvement.

5.5.2 Peer reviewed published paper: Improving disaster data systems to inform disaster risk reduction and resilience building in Australia: a comparison of databases

Improving Disaster Data Systems to Inform Disaster Risk Reduction and Resilience Building in Australia: A Comparison of Databases

Joseph Cuthbertson, MPH, MSC, MEH;¹  Frank Archer, MD, PhD;¹ Andy Robertson, MD, CSC, PSM;² Jose M. Rodriguez-Llanes, DrPH³

1. Monash University Disaster Resilience Initiative, Melbourne, Victoria, Australia
2. Western Australia Department of Health, Perth, Western Australia
3. European Commission, Joint Research Centre, Ispra, Italy

Correspondence:

Dr. Jose M. Rodriguez-Llanes
European Commission Joint Research Centre
Directorate of Sustainable Resources
D5 Via Fermi 2749, TP272 21027 Ispra
(VA), Italy
E-mail: jose-manuel.rodriguez-llanes@ec.europa.eu

Conflicts of interest/funding: none

Keywords: disaster; disaster data; disaster database; disaster measurement; risk reduction

Abbreviations:

AIDRKH: Australian Institute Disaster Resilience Knowledge Hub
CE-DAT: Complex Emergencies Events Database
CRED: Centre for Research on the Epidemiology of Disasters
DRR: Disaster Risk Reduction
EM-DAT: Emergency Events Database
UN: United Nations
UNDP: United Nations Development Program

Received: December 16, 2020

Revised: March 3, 2021

Accepted: May 16, 2021

Abstract

Objective: Disaster impact databases are important resources for informing research, policy, and decision making. Therefore, understanding the underpinning methodology of data collection used by the databases, how they differ, and quality indicators of the data recorded is essential in ensuring that their use as reference points is valid.

Methods: The Australian Disaster Resilience Knowledge Hub (AIDRKH) is an open-source platform supported by government to inform disaster management practice. A comparative descriptive review of the Disaster Mapper (hosted at AIDRKH) and the international Emergency Events Database (EM-DAT) was undertaken to identify differences in how Australian disasters are captured and measured.

Results: The results show substantial variation in identification and classification of disasters across hazard impacts and hazard types and a lack of data structure for the systematic reporting of contextual and impact variables.

Conclusions: These differences may have implications for reporting, academic analysis, and thus knowledge management informing disaster prevention and response policy or plans. Consistency in reporting methods based on international classification standards is recommended to improve the validity and usefulness of this Australian database.

Cuthbertson J, Archer F, Robertson A, Rodriguez-Llanes JM. Improving disaster data systems to inform disaster risk reduction and resilience building in Australia: a comparison of databases. *Prehosp Disaster Med.* 2021;36(5):511–518.

Introduction

The frequency and severity of natural disasters is increasing, the effects of which are spread over greater geographical and increasingly populated areas. In the Australian context, the increasing risk to the built and natural environments related to increasing frequency and intensity of extreme weather events is described by the National Strategy for Disaster Resilience.¹ Such risks have been realized by vast bushfires which swept across multiple states causing widespread destruction on the east coast of Australia over the summer of 2019/2020. To empower principles of “building back better,” resiliency, and supporting future disaster risk reduction (DRR) efforts and policy interventions in this context, an accurate understanding of hazards, threats, risks, and vulnerabilities is required. Measurement and understanding of the impacts caused by disaster informs policy makers and operational decision makers on investment strategies related to disaster. However, disaster risk analysis varies between institutions, partly due to differences in how disaster threats are defined and measured, and thus quantified. Previous studies in Australia measuring heatwave, a common Australian hazard, have demonstrated challenges in standardization of terminology and definitions, as well as data collection.²

The main weakness with disaster data is the lack of standardized methodologies and definitions for the inclusion of disasters³ and robust impact measurement

doi:[10.1017/S1049023X2100073X](https://doi.org/10.1017/S1049023X2100073X)

© The Author(s), 2021. Published by Cambridge University Press on behalf of World Association for Disaster and Emergency Medicine. This is an Open Access article, distributed under the

terms of the Creative Commons Attribution licence (<http://creativecommons.org/licenses/by/4.0/>), which permits unrestricted re-use, distribution, and reproduction in any medium, provided the original work is properly cited.

DISASTER MAPPER	EM-DAT
A disaster, as defined by the Australian Institute for Disaster Resilience, is a serious disruption to community life which threatens or causes death or injury in that community and/or damage to property which is beyond the day-to-day capacity of the prescribed statutory authorities and which requires special mobilization and organization of resources other than those normally available to those authorities. ¹⁴	EM-DAT defines a disaster as: “A situation or event which overwhelms local capacity, necessitating a request to a national or international level for external assistance; an unforeseen and often sudden event that causes great damage, destruction, and human suffering.” ¹⁵

Cuthbertson © 2021 Prehospital and Disaster Medicine

Box 1. Disaster Definitions in EM-DAT and Disaster Mapper

methodologies.⁴ Accurate accounting for disaster impacts is a critical aspect of improving disaster risk management, DRR, and resilience building.⁵ Historical data are commonly used by analysts to track disaster trends and causal factors both over time and geographically. At subnational levels, disaster databases provide key information to signal hotspots of hazard or risk and design locally tailored actions plans or investigate regional trends. They can also be used to monitor progress in effectiveness of government strategies to reduce disaster impacts on population health and the economy.

Demand for clear, accurate, and consistent reporting of economic impact related to disaster in Australia is driven primarily from government and academia/research. Whilst a number of individual hazard-specific reports have been produced to date, the only comprehensive national impact assessment of economic loss related to disaster in Australia was conducted by The Bureau of Transport Economics (BITRE; Canberra, Australian Capital Territory) in 2001.⁵

Other disaster databases include data from Australia such as DesInventar,⁶ Swiss RE: Sigma,⁷ and Munich RE: NatCat.⁸ In the Oceania region, reporting systems include the Australia Disaster Assist⁹ and the Insurance Council of Australia Catastrophe Database,¹⁰ which reports on insurance losses from 1967 to the present. At the time of writing, a new database has been developed using data from the Australian Institute for Disaster Resilience (Melbourne, Victoria, Australia) Knowledge Hub (AIDRKH) and is currently available on request.¹¹

This paper provides a comparative, descriptive review of disaster hazards in Australia as measured by a domestic disaster database, The Disaster Mapper at AIDRKH, and an international one, the Emergency Events Database (EM-DAT), to gain new insights on its compatibility with international standards of disaster data classification, reporting, and access.

Methods

Studies comparing databases on disaster losses have broadly differed in their methodological approaches,³ ranging from narrative descriptions to mixed methods analyses¹² and expert assessments or systematic reviews.¹³ Methodologies must be adapted to the purpose of the particular study and other constraints. This study used a combination of qualitative (eg, disaster definitions) and quantitative methods (eg, number of disaster events) to conduct the presented comparisons.

A comparative descriptive review of a national and an international disaster database was undertaken to examine differences in disaster definition and data entry thresholds, classification, impact (human, economic, and contextual), as well as accessibility and data structure. The choice of these variables was based on the review of past efforts to compare disaster databases.^{3,12,13} The databases used in the comparative review were the Australian Disaster Mapper based at the AIDRKH¹⁴ and

the EM-DAT database of the Belgium-based Centre for Research on the Epidemiology of Disasters (CRED; Brussels, Belgium).¹⁵ These were purposively selected as the aim of the study was to provide a detailed account of whether the Disaster Mapper fulfills international standards for disaster databases according to a recognized and long-lasting initiative.

To conduct these comparisons, relevant information was scrutinized and extracted, including data, definitions, and classifications of the abovementioned variables from the corresponding sections of both websites.^{14,15} Relevant data on disasters and their impacts were downloaded to compare disaster frequencies for comparable categories of disasters, whenever possible.

The AIDRKH Disaster Mapper contains information on disasters affecting Australia and some international disasters that have impacted Australians since 1869. The Disaster Mapper was designed to support and inform policy, planning, decision making, and practice in disaster resilience and is managed by the Australian Institute for Disaster Resilience on behalf of the Australian Government. The Disaster Mapper includes natural, technological, and human-caused events that have a significant impact on Australia and its population. It is presented as an interactive visualization tool of disasters in Australia, supported by the annual Major Incident Reports involving Australian fire and emergency services. Disaster Mapper is likely the most comprehensive, publicly available national dataset, according to authors' knowledge.

In 1988, CRED created the EM-DAT with initial support from the World Health Organization (WHO; Geneva, Switzerland) and the Belgian Government. The EM-DAT houses international disaster impact data from 1900 to the present day. The objective of the database is to serve and support national and international decision making for disaster preparedness, vulnerability assessment, and prioritize resource allocation for disaster response. The EM-DAT is a world-recognized and internationally-standardized source for disaster data and widely used by the United Nations (UN), international organizations, politicians, and academia.

Results

Disaster Definitions

The United Nations Office for Disaster Risk Reduction (UNDRR; Geneva, Switzerland) defines a disaster as “a serious disruption to the functioning of a community, which causes human, material, economic, and environmental losses beyond a community's ability to cope.”¹⁶ The definitions of disaster used by each of the investigated databases are shown in Box 1. The definitions of disaster in the Disaster Mapper and EM-DAT are, with their lexical differences, well-aligned. They provide a clear understanding that disaster is a situation exceeding or overwhelming available resources at a certain level of aggregation, social or geographical, causing personal and/or material damage, and requiring more resources than those available at the affected communities.

	Disaster Mapper	EM-DAT
Disaster Entry Thresholds	A disaster, as defined by Disaster Mapper, is three or more deaths; or 20 injuries or illnesses; or significant damage to property, infrastructure, agriculture, or the environment; or disruption to essential services, commerce, or industry at an estimated total cost of A\$10 million or more at the time the event occurred; and include event occurring in Australia or directly impacting on Australians. ¹⁰	A disaster, as defined by the EM-DAT database, is ten or more people reported killed, or one hundred or more people reported affected, or declaration of a state of emergency or a call for international assistance. ¹¹
Reported Variables (Impact and Context)	Disaster Mapper database entries include date of event (Temporal Coverage 1753 – 2014), location (state and country), and disaster category. Narrative text accessible per event online contains additional information contextual to the event. ¹⁰	The EM-DAT database includes information on the location (country or countries in which the disaster has occurred), the exact date of the disaster (start and end whenever possible), disaster categories, number of deaths, number of people injured, number of people homeless, number of people affected, and estimated economic damage. ¹¹

Cuthbertson © 2021 Prehospital and Disaster Medicine

Table 1. Disaster Database Entry Thresholds and Summarized Recorded Variables
Abbreviation: EM-DAT, Emergency Events Database.

Disaster Database Entry Thresholds

Disaster databases apply criteria related to their respective definition of disaster that prescribe which events do and do not get recorded. Table 1 shows the entry criteria used by the two examined databases in this research. The mortality entry threshold, one consistently used across databases, was lower in the Disaster Mapper compared to EM-DAT, which could yield an increased ability to report disasters in the former.

Disaster Classifications

The Hazard and Peril Glossary is used for describing and categorizing disasters in the EM-DAT database, shown in Table 2.¹⁷ The Disaster Mapper database does not contain specific disaster definitions, yet it includes 17 disaster categories, which at times were found to be different compared to those in EM-DAT. Table 2 presents the disaster categorizations in both databases, in which EM-DAT contains more sub-categories of disasters. A notable difference is the use of a category labelled “environment” (Disaster Mapper) to classify extreme temperature and droughts (EM-DAT).

Impact Variables

The National Disaster Resilience Strategy endorses the consideration of risk and risk treatment across social, built, economic, and natural environments of a community.¹ The Australian Institute for Disaster Resilience describes these four as recovery impact environments in the National Disaster Risk Reduction Framework.^{18,19} When planning for community needs, this framework guides planners on the interdependency of the four environments in considering and coordinating interventions.

Event impact variables provided by the Disaster Mapper vary between event type; however, deaths and injured due to an event are commonly reported in narrative text related to the event when accessed individually online. Event impact data of both databases are shown in Table 3.

Context Variables

Raw data in EM-DAT database contain further, context-related information not visible via the online portal. These context variables are described in Table 4.

All events recorded in the Disaster Mapper can be individually viewed and contain a brief narrative of the event and its impact from

where some contextual variables could be potentially obtained. Annual major incident reports have been produced by AIDKH for the last three years based on database inputs.

Database Accessibility

The EM-DAT database is accessed through an online portal requiring a username and password applied for through the CRED website. The EM-DAT database provides several standardized reports that can be generated and customized to region, country, and disaster. Advanced search functions on EM-DAT allow for specific event searches and automatic report generation, the data of which can be extracted. Access requires registration as a user.

Events recorded in the Disaster Mapper are publicly accessible and can be viewed as multiple or single disaster categories; however, event data can only be accessed per event and report or data extraction is not available through direct online access.

Disaster Database Recorded Events

All disaster data were manually extracted from the Disaster Mapper database. As of November 1, 2019, a total of 416 events had been entered: 396 of these were events that occurred in Australia and 20 events that affected Australian nationals abroad occurred internationally. Table 5 shows Disaster Mapper events by category type in order of number of events (top 10) built using all available data from 1869 to 2019. Table 6 is a direct extract of data from EM-DAT, which shows Australian disasters from 1900 to 2019 also in order of number of events (top 10).

Whilst the original start date of recording of data differs between the two databases (1869 versus 1900), there were only seven (7) events recorded in the difference between these time periods: five (5) floods and two (2) industrial accidents.¹⁶ Inclusion of these events does not substantially alter the proportionate difference in numbers of events or make the databases more comparable. The observed trends in these comparisons were overall as expected. With increased sensitivity in Disaster Mapper, this database recorded increased number of floods and wildfires, with very substantial differences for epidemic outbreaks and industrial accidents. Storms and droughts presented more comparable numbers across databases, while other categories could not be assessed from Table 5 and Table 6.

CRED Emergency Events Database (EM-DAT)				Disaster Mapper
Disaster Group	Disaster Sub-Group	Definition	Disaster Main Type	Disaster Category
Natural	Geophysical	A hazard originating from solid earth. This term is used interchangeably with the term geological hazard.	Earthquake	Earthquake
			Mass Movement (dry)	Landslide
			Volcanic Activity	
	Meteorological	A hazard caused by short-lived, micro- to meso-scale extreme weather and atmospheric conditions that last from minutes to days.	Extreme Temperature	Environment
			Fog	
			Storm	Storm
				Cyclone
				Tornado
	Hydrological	A hazard caused by the occurrence, movement, and distribution of surface and subsurface fresh-water and saltwater.	Flood	Flood
			Landslide	Landslide
			Wave Action	Tsunami
	Climatological	A hazard caused by long-lived, meso- to macro-scale atmospheric processes ranging from intra-seasonal to multi-decadal climate variability.	Drought	Environment
			Glacial Lake Outburst	
			Wildfire	Fire – Bushfire
	Biological	A hazard caused by the exposure to living organisms and their toxic substances (eg, venom, mold) or vector-borne diseases that they may carry. Examples are venomous wildlife and insects, poisonous plants, and mosquitoes carrying disease-causing agents such as parasites, bacteria, or viruses (eg, malaria).	Epidemic	Health
			Insect Infestation	Biosecurity
			Animal Accident	
	Extra-Terrestrial	A hazard caused by asteroids, meteoroids, and comets as they pass near-earth, enter the Earth's atmosphere, and/or strike the Earth, and by changes in interplanetary conditions that effect the Earth's magnetosphere, ionosphere, and thermosphere.	Impact	
			Space Weather	
Technological	Industrial Accident		Chemical Spill	Industrial
			Collapse	
			Explosion	
			Fire	
			Gas Leak	
			Poisoning	
			Radiation	
			Oil Spill	
			Other	
	Transport Accident		Air	Transport
			Road	
			Rail	
	Miscellaneous Accident		Water	Maritime/Coastal
			Collapse	Industrial
			Explosion	Fire - Urban
			Fire	
			Other	Criminal
				Other Disasters

Cuthbertson © 2021 Prehospital and Disaster Medicine

Table 2. Comparison of Disaster Classifications in EM-DAT and Disaster Mapper
Abbreviation: EM-DAT, Emergency Events Database.

Furthermore, the Disaster Mapper contains an “Other” category where two recorded events have been entered. Box 2 shows a summary of these events. In contrast, the EM-DAT database does not record war or conflict-related events.

The EM-DAT database does include a category of miscellaneous accident in the technological category, which also holds an “other” selection. Only one event in this category has been captured in the EM-DAT database relating to an event occurring in 1990

CRED Emergency Events Database (EM-DAT) Impact Data Categories			Disaster Mapper Environments
Impact	Health	Death	Social Environment
		Missing	
		Total Deaths (deaths + missing)	
		Injured	
		Affected	
		Homeless	
	Economic	Total Estimated Damages (in 000US\$ current value)	Economic Environment
		Reconstruction Cost (in 000US\$ current value)	
		Insured Losses (in 000US\$ current value)	
	Disaster	Sectors Affected by the Disaster (Animals, Industry, Electricity, Water Supply/Sanitation, Communications, Cultural Infrastructure, Transportation, Other)	Built Environment
		Infrastructure (infrastructure damaged or destroyed by the disaster, given in absolute values or percentages)	
		Comments (all other relevant information)	Natural Environment
		Other	

Cuthbertson © 2021 Prehospital and Disaster Medicine

Table 3. Disaster Impact Variables in EM-DAT and Disaster Mapper

Abbreviations: CRED, Centre for Research on the Epidemiology of Disasters; EM-DAT, Emergency Events Database.

Thematic Classifications	Variables
Geographical Information	Country (if a disaster has affected more than one country, there will be one entry for each country)
	ISO Code (International Organization for Standardization 3-letter code for each country)
	Region (as per the UN regional division)
	Continent
	River Basin (if flood event)
	Latitude/Longitude/Location (eg, name of a city, village, department, province, state, or district)
Temporal Information	Start Day/Month/Year
	End Day/Month/Year
	Local Time
Physical Characteristics	Origin
	Associated Disasters 1 and 2 (ie, landslide post-earthquake)
	Disaster Magnitude Scale and Value
	Other
Status	Aid Contribution: Total Amount (given in 000US\$)
	OFDA Response
	Appeal for International Assistance and Date
	Declaration of Disaster and Date

Cuthbertson © 2021 Prehospital and Disaster Medicine

Table 4. Context Variables in EM-DAT

Abbreviations: EM-DAT, Emergency Events Database; UN, United Nations; OFDA, Office of US Foreign Disaster Assistance.

that resulted in 25 deaths. Following inquiry with the database management team, no detailed information was available to describe this event.

Other notable differences include the categories of “health” and “criminal” in the Knowledge Hub. Further investigation of the

“health” category revealed details of events such as heatwaves, food poisoning, listeria, gastroenteritis, coral poisoning, poliomyelitis, bubonic plague, Spanish flu, and bird flu (H1N1) events. These events are captured and recorded in different categories listed in EM-DAT (ie, biological, meteorological).

Australian Disaster Mapper Categories	Number of Events 1869-2019
Flood	80
Fire – Bushfire	65
Industrial	53
Cyclone	45
Storm	39
Health	34
Fire – Urban	20
Transport	19
Environment	14
Criminal	7

Cuthbertson © 2021 Prehospital and Disaster Medicine

Table 5. Australian Disaster Mapper Disasters (Top 10 by Number of Events)

EM-DAT Disaster Type	Number of Events 1900-2019
Storm	107
Flood	64
Wildfire	41
Transport Accident	23
Drought	11
Miscellaneous Accident	8
Extreme Temperature	7
Earthquake	4
Epidemic	2
Industrial Accident	2
Insect Infestation	2
Landslide	2

Cuthbertson © 2021 Prehospital and Disaster Medicine

Table 6. EM-DAT Australian Disaster Events (Top 10 by Number of Events)
Abbreviation: EM-DAT, Emergency Events Database.

August 5, 1944	A Prisoner of War (POW) attempted mass escape in Cowra, New South Wales resulted in 235 deceased and 108 injured
February 19, 1942	Wartime bombing in Darwin, Northern Territory resulted in 243 deceased and 400 injured

Cuthbertson © 2021 Prehospital and Disaster Medicine

Box 2. Australian Disaster Mapper Database “Other” Events

Investigation of the “criminal” category in the Knowledge Hub found ten (10) events, five (5) of which were terrorist events that occurred overseas. The EM-DAT database does not include terrorist attacks or other criminal-related events as a disaster category. The Australian Institute for Disaster Resilience has published three (3) reports based on events recorded in the Knowledge Hub. Titled “Major Incidents of the Year,” reports for 2016-2017, 2017-2018, and 2018-2019 have been produced. Each

report provides an overview of major incidents that have involved the fire and emergency services sector during the corresponding financial year. The intent of the reports is to examine incidents identified by the sectors that were of significant impact or consequence for fire and emergency services. The reports are not a review of all incidents occurring during the period defined and are intended to provide key insights related to the events described. These publications provide a user-friendly resource for emergency service operators to engage with lessons learned in their field. Currently, CRED provides a biannual newsletter based on EM-DAT data, an Annual Disaster Statistical Report, and CRED Crunch, a newsletter published typically every three to six months. The newsletter focus is broad and reflective of international disasters. On occasion, EM-DAT data are used for international reports with a thematic focus.

Discussion

This study compared essential characteristics of the EM-DAT database and the Disaster Mapper disaster impact databases focusing on records from Australia. Whereas both databases emerge from similar definitions of disasters, substantial differences were found. A lack of some categories and general absence of definitions were noted when comparing them. An even more important aspect was the lack of a clearer data structure to report contextual and impact variables. Disaster Mapper considered war-related events not considered in EM-DAT, and considered the environmental impact of disasters and not just the direct human impacts. Entry criteria for an event in the Disaster Mapper appears to align with the published criteria for the Australian Disasters Collection by including “natural, technological, and human-caused events that have a significant impact on Australia and its people.” It is not clear how significance is calculated for international events, as other impacts on Australian Nationals abroad, such as the downing of Malaysia Airlines Flight 17 (MH17) on July 17, 2014 resulting in the death of 283 passengers, including 38 Australians, has not been included. Additionally, other historic natural disaster impacts, such as the volcanic eruption in Papua New Guinea (then a territory of Australia) that resulted in 4,000 deaths, are missing from the Disaster Mapper.²⁰ It is unclear how or why events were selected for inclusion and others were not.

The EM-DAT database does not record war or conflict-related events. Alternately, CRED has identified events related to the impact of war or conflict as “complex emergencies” from which the Complex Emergencies Events Database (CE-DAT) was developed and captures humanitarian emergency impact data. The intent of CE-DAT was monitoring and evaluation of the health status of populations affected by complex emergencies. The CE-DAT was initiated in 2003 to predominantly measure mortality and malnutrition from surveys conducted in humanitarian crises. The CE-DAT database is not currently operational.

The EM-DAT possesses a hierarchical clustering of main disaster categories and sub-categories, which could be used by Disaster Mapper to improve its classification structure and assist in addressing absence of categories for mass movement, meteorites, and volcanic activity.

Further comparisons of the datasets are challenging due to accessibility options. Whilst EM-DAT enables spreadsheet downloading of the data, Disaster Mapper data require manual extraction and configuration into usable tables. Overall, the differences in data collection and functionality between the two databases limit

meaningful comparison. For data users, this can potentially challenge database utility for policy guidance, development, and decision making.

Consistent with the study results here, internationally led research has compared disaster loss databases in efforts to improve understanding of disaster impact. A report commissioned by the United Nations Development Program (UNDP; New York USA) reviewed country and regional disaster databases and highlighted that in the Asia Pacific region, of 19 different national databases that were identified, five (including Australia) had stand-alone methodologies for disaster event capture and recording.²¹ The remainder used DesInventar definitions and classifications. Disaster information captured by DesInventar format databases include: type of event, province/State, district, date, location, deaths, missing, injured, affected, victims, evacuated, relocated, houses damaged, houses destroyed, crops and woods (hectares), livestock (lost), educational centers, hospitals, loss value in local currency and USD (calculated according to the exchange rate on the date of the disaster), roads affected, and other data fields up to a maximum of 17 additional parameters (including data sources for each of the records).⁶ The Australian database examined by UNDP was reported as including event title, zone, region, category, start date, end date, dead, injured, and the insured total losses due to the disaster itself. Interestingly, the reference used by the report related to Australian disaster data is the Emergency Management Australia Disasters Database.²² The data set was created on May 2, 2014 and last updated on December 16, 2016 as a CSV format list of all Australian Emergency Management Knowledge Hub disaster events, including disaster category, impacts, and geographic coordinates. The dataset is publicly available for download but shows a difference in disaster events recorded (a total of 674) compared to Disaster Mapper.

Key findings noted by the UNDP report included opportunities for improvement in currency (up to date information), completeness (data gaps), quality assurance (having a documented quality control procedure), applications (use of the dataset for research or policy support), accessibility (having open access), and standardization (using consistent methodology). The report endorsed recommendations to improve disaster loss databases in respect to these criteria and defined the ideal loss and damage database as “one that is sustainable, continuous, credible, publicly accessible, quality assured, and applied for decision making.”²¹ These recommendations are consistent with findings of an investigation into disaster data interoperability in Europe by Migliorini, et al who noted a lack of long-term DRR activities related to data capture and usage.²³

The EM-DAT is one of very few global disaster event databases. The EM-DAT, along with other international databases, relies predominantly on media sources, international organizations (ie, UN, Red Cross), and/or non-governmental organization reports, resulting in a lack of readily available access to event data that national services possess. Consistent standards of data capture and shared access may enhance research capability to investigate disaster impact events. Findings from De Groeve, et al recommended guidelines and standards for data collection and recording, with a focus on human and economic losses, to enable data sharing in a comparable way.¹³

An investigation into decision making related to disaster resilience in Australia conducted by Deloitte found that gaps existed across categories of data and that “significant barriers exist to the better provision, sharing, and quality of natural disaster data sets.”

Recommendations noted by Deloitte include a more coordinated approach to natural disaster data to reduce cost and support the quality of research activities and decision making related to resilience investments, and reduce the duplication of data collection and analysis.²⁴

In a study using both CRED data and Knowledge Hub entry data, Bradt, et al sought to determine the profile of Australian Disaster since 1900. Large variations in data capture and classification were also identified by the author. To account for this and enable a sharper analysis, a methodology was developed by the author and applied using additional criteria in order to exclude events not deemed of national significance.²⁵

The collection of accurate disaster loss information is of relevance to many stakeholders. Hallegatte, et al reported national and subnational levels of government, the insurance sector, the private sector, and the local and international community as having invested interest in disaster loss information to guide risk plans and actions.²⁶

As described by De Groeve, et al, one of the main sources of incompatibilities between databases is the lack of precise and agreed definitions of hazards and loss indicators.¹³ The analysis here is coincident with the above statement. Enhancement of the Australian database could be achieved through adoption of the Integrated Research on Disaster Risk Programme hazard and peril classification, which is widely adopted across national and international databases. This classification distinguishes three levels: the event family (the most generic), the main event type, and peril (the most specific).¹⁷ These findings are consistent with the outcomes of a review of selected disaster databases by Tschoegl, et al who conducted a high-level overview of international and national disaster database methodologies.²⁷

Australia is a signatory to the Sendai Framework for Disaster Risk Reduction, Priority 2, of which is “Strengthening disaster risk governance to manage disaster risk.”²⁸ Differences in hazard definitions, lack of certain hazard categories, and varying entry criteria may result in inclusion of events in one dataset that may not be included in the other. This, in turn, can alter perception of, and decision making related to, risk and vulnerability to hazards or biased disaster response. Addressing this issue is of particular relevance as Australian disaster reporting seeks to move from a response to a prevention approach.¹⁸

There is no national strategy, organization, or capability to systematically capture, measure, and evaluate disaster event occurrence, impact, and outcomes and from this analyze and implement lessons and findings into policy or practice. The recently released report of the Royal Commission into National Natural Disaster Arrangements has recommended improvements in national practices of disaster data collection. In particular, implementation of harmonized data governance and national data standards and development of consistent data standards to measure disaster impact.²⁹

The findings of this paper identify opportunities for improvement. This includes a recommendation of review of Australian disaster database hazard classification and definitions in alignment with the Integrated Research on Disaster Risk Programme hazard and peril classification. Further to this, standardization and systematic reporting of disaster data utilizing an agreed, fixed data structure including context and impact variables internationally is recommended. Finally, to enhance utility for generation of rapid situation reports or customized reports online, disaster database data extraction capability is recommended.

Limitations

This study is not exempt from limitations, including the comparison of only two databases. Limited accessibility was observed at the time of the study. It should be noted that EM-DAT has enabled public access after this analysis was completed. This research was conducted from an Australian perspective and may lack validity outside of that perspective.

Conclusion

This paper provides a comparative analysis of disaster hazard and threat data of Australian events as measured by The Australian

Disaster Mapper and the CRED EM-DAT database. Differences in categorization and classification were identified, which may have implications for reporting and analysis. Further investigation to understand how significant events are identified for inclusion in disaster categories, and how their inclusion impact decision making for DRR activities in Australia, is warranted. Consistency in reporting methods based on international classification standards is recommended to improve the validity and usefulness of this Australian database.

References

1. Council of Australian Governments. *National Strategy for Disaster Resilience. Building the Resilience of Our Nation to Disasters*. Australian Capital Territory: COAG; 2011.
2. Coates L, Haynes K, O'Brien J, McAneney J, De Oliveira FD. Exploring 167 years of vulnerability: an examination of extreme heat events in Australia 1844–2010. *Environmental Science & Policy*. 2014;42:33–44.
3. Guha-Sapir D, Below R. *The Quality and Accuracy of Disaster Data: A Comparative Analyses of 3 Global Data Sets*. Centre for Research on the Epidemiology of Disasters (CRED) Working Paper. Brussels, Belgium: CRED; 2002.
4. Ladds M, Keating A, Handmer J, Magee L. How much do disasters cost? A comparison of disaster cost estimates in Australia. *Int J Disaster Risk Reduction*. 2017;21:419–429.
5. Bureau of Transport Economics. *Economic Cost of Natural Disasters in Australia*. Report 103. Canberra, Australian Capital Territory: BOTE; 2001.
6. United Nations Office for Disaster Risk Reduction. DesInventar. UNISDR Disaster Information System. <https://www.desinventar.net/>. Accessed April 2, 2020.
7. Swiss Re. Sigma. Economic Research and Consulting. <https://www.swissre.com/institute/search-page.html?searchterm=Economic+Research+and+Consulting>. Accessed April 2, 2020.
8. Munich Re. Disaster loss data. NatCat Service. <https://www.munichre.com/en/solutions/for-industry-clients/natcatservice.html>. Accessed April 2, 2020.
9. Disaster Assist. <https://www.disasterassist.gov.au/Pages/australian-disasters.aspx>. Accessed April 2, 2020.
10. Insurance Council of Australia (ICA). 2015, *Historical disaster statistics*. Sydney, Australia: Insurance Council of Australia. <https://www.insurancecouncil.com.au/industry-statistics-data/disaster-statistics/historical-disaster-statistics>. Accessed April 2, 2020.
11. Handmer J, Ladds M, Magee L. Updating the costs of disasters in Australia. *Austral J Emerg Manag*. 2018;33(2):40.
12. Stratton SJ. Using pre-existing databases for prehospital and disaster research. *Prehosp Disaster Med*. 2015;30(1):1–3.
13. De Groeve T, Poljansek K, Ehrlich D, Corbane C. Current status and best practices for disaster loss data recording in EU member states: a comprehensive overview of current practice in the EU member states. *JRC Scientific and Policy Report*. JRC92290.
14. Australian Emergency Management. Australian Emergency Management Knowledge Hub. www.emknowledge.gov.au. Accessed April 2, 2020.
15. EM-DAT: The CRED/OFDA International Disaster Database. <https://www.emdat.be/>. Accessed April 2, 2020.
16. United Nations International Strategy for Disaster Reduction. *UNISDR Terminology on Disaster Risk Reduction*. Geneva, Switzerland: UNISDR; 2009.
17. IRDR DATA Working Group. *Peril Classification and Hazard Glossary*. DATA Project Report. Beijing, China: IRDR; 2014.
18. National Resilience Taskforce. *The National Disaster Risk Reduction Framework*. Canberra, Australian Capital Territory: Department of Home Affairs; 2018.
19. National Emergency Risk Assessment Guidelines. *Australian Disaster Resilience Handbook Collection*. Melbourne, Victoria, Australia: Australian Institute for Disaster Resilience; 2015.
20. Belshaw CS. Social consequences of the Mount Lamington eruption. *Oceania*. 1950;21:241.
21. Grasso V, Dilley M. *A Comparative Review of Country-Level and Regional Disaster Loss and Damage Databases*. New York USA: United Nations Development Programme Bureau for Crisis Prevention and Recovery; 2013.
22. Australian Government Data Portal. Disaster Events with Category Impact and Location. Attorney-General's Department; 2014. <https://data.gov.au/data/dataset/disaster-events-with-category-impact-and-location>. Accessed January 8, 2020.
23. Migliorini M, Hagen JS, Mihaljević J, et al. Data interoperability for disaster risk reduction in Europe. *Disaster Prevention and Management*. 2019;28(6).
24. Deloitte Access Economics. *Building An Open Platform for Natural Disaster Resilience Decisions*. Sydney, New South Wales, Australia: Deloitte Access Economics; 2014.
25. Bradt DA, Bartley B, Hibble BA, Varshney K. Australasian disasters of national significance: an epidemiological analysis, 1900–2012. *Emerg Med Australas*. 2015;27(2):132–138.
26. Przyłuski V, Hallegatte S. Indirect costs of natural hazards. *CONHAZ Report WP02*. 2011;2:383–398.
27. Tschöegl L, Below R, Guha-Sapir D. *An Analytical Review of Selected Data Sets on Natural Disasters and Impacts*. Brussels, Belgium: Centre for Research on the Epidemiology of Disasters; 2006.
28. United Nations. *Sendai Framework for Disaster Risk Reduction 2015–2030*. Geneva, Switzerland: UNDRR; 2015.
29. Royal Commission into National Natural Disaster Arrangements. *Report*. Canberra, Australian Capital Territory: Commonwealth of Australia; 2020.

5.5.3 Discussion

This paper identified the importance of consistency and quality in reporting the impacts of disasters by comparing a global and national disaster database. The recommended improvements if adopted will assist to improve guidance on risk reduction activities. The next chapter reports on the qualitative data analysis undertaken in stage 1.

5.6 STAGE 1 QUALITATIVE DATA ANALYSIS

5.6.1 Introduction

The previous chapter explored database systems, data analysis and published works based on the findings of the analysis undertaken. This chapter reports the qualitative data analysis undertaken in stage 1.

5.6.2 Methodology

35 requests for interview by email or face to face were requested, 30 accepted the request and 5 did not respond (email request). No potential interviewees refused to participate. Data collection was conducted between April 2017 and November 2017, a typical interview lasted between 45 – 60 minutes.

30 individual interviews with participants from 9 different countries were conducted by face to face, Skype or telephone call (Appendix 1). All of the participants were engaged in disaster management in the Oceania region as researchers, practitioners, policy managers or academics. Interviews were ceased when responses indicated no new information was obtained and information saturation had occurred. The Hazard and Peril Glossary for describing and categorising disasters applied by the Centre for Research and Epidemiology in Disasters (CRED) was used to guide coding of data for interview question one and two. Coding for the remaining interview questions and thematic analysis relative to research question one and two was conducted using narrative inquiry according to the six step process described by Braun and Clarke[71]:

Phase One: Data familiarisation, coding of interview questions one and two (box 1)

Phase 2: Generating initial transcript codes (box 2)

Phase 3: Searching for themes

Phase 4: Reviewing potential themes (table 1)

Phase 5: Defining and naming themes (table 2)

Phase 6: Producing the report (published)

Thematic Analysis:

Phase One: Data familiarisation

Participant Gender: <ul style="list-style-type: none"> • Male: 14 • Female: 16
Participant Location: Hawaii (1), Geneva (1), Australia (18), New Zealand (2), Timor Leste (2), Indonesia (2), Fiji (2), Tonga (2).

<p>Question One:</p> <p>23 answers associated with urbanisation:</p> <ul style="list-style-type: none"> • 5 transport accident • 1 pollution • 1 urban fires • 6 infrastructure failure • 2 chemical or oil spill • 5 rapid/unsustainable urbanisation <p>3 answers associated with food and water insecurity</p> <p>21 answers associated with terrorism/conflict</p> <p>22 answers associated with disease</p> <ul style="list-style-type: none"> • 17 pandemic/infectious • 5 NCD/obesity/ageing <p>69 answers associated with natural disasters:</p> <ul style="list-style-type: none"> • 19 earthquakes • 19 storm/cyclone • 3 bushfires • 11 floods • 1 heat wave • 11 tsunamis • 5 droughts
<p>Question Two:</p> <p>13 answers associated with terrorism/conflict:</p> <ul style="list-style-type: none"> • 1 cyber attack <p>13 answers associated with urbanisation:</p> <ul style="list-style-type: none"> • 1 pollution • 3 MVA • 3 food and water insecurity • 6 power/technology security <p>4 answers associated with migration</p> <p>11 answers associated with climate change</p> <p>20 answers associated with disease:</p> <ul style="list-style-type: none"> • 16 pandemic/infectious disease • 4 NCD <p>22 answers associated with natural disasters</p> <ul style="list-style-type: none"> • 4 earthquakes • 3 storm/cyclone • 1 drought • 3 bushfires

- 2 tsunamis
- 4 heat related
- 5 floods

Natural disasters (86/38) responses including disease) are perceived to be the greatest contemporary and emerging threat in Oceania
When comparing thematic response to question one against the recorded previous decade of disaster impacts from CRED it can be seen that six natural disasters were recorded on the CRED international disaster database for the year of 2017, predominantly affecting Australia and Vanuatu.

Disasters in Oceania: 2017

Year	Country Name	Disaster Type	Occurrence	Total Deaths	Injured	Affected	Homeless	Total Affected	Total Damage (\$USD)
2017	Australia	Storm	1	12		20000		20000	2700000
2017	Australia	Wildfire	1		2	27	114	143	20000
2017	French Polynesia	Flood	1			4500	500	5000	2000
2017	New Zealand	Flood	1			2200		2200	
2017	Vanuatu	Storm	1			2564		2564	
2017	Vanuatu	Volcanic activity	1			11000		11000	

[75]

Many answers describing emerging risk in Oceania in the next 10 years did not fit the profile of definitions described by CRED. In particular themes identified within the terrorism category were less focussed on violence and more centred on reasons including internal conflict, political unrest, migration and extremism

Phase Two

Box 2: Coded transcript

Transcript	Codes
<ul style="list-style-type: none"> • <i>Climate change, lack of water, heat related injuries/consequences, cyclones and natural disasters increasing in severity.</i> 	Climate change is viewed as a contemporary and emerging disaster risk in Oceania. Climate change identified as a

<ul style="list-style-type: none"> • <i>Climate change, diseases, trans-nation migration due to climate change.</i> • <i>Increasing global warming influencing natural disaster risk</i> • <i>Populations are vulnerable to emerging risks, overall vulnerability is increasing due to climate change with more hot days and less cool days.</i> • <i>Climate change – its impact on livelihood and health.</i> • <i>Climate change, lack of ability of communities to cope with impact</i> 	<p>current or emerging threat in 21 instances Q1/Q2</p>
<ul style="list-style-type: none"> • <i>Urbanisation/industrialisation with population growth, climate issues in island areas and loss of land mass, new/ mutated diseases.</i> • <i>Public health issues, novel virus strains in poorer nations due to frequent travel in the region. Terrorism and bio attack and/or terrorism hazards by polluting food and/or water. Bushfire.</i> • <i>The changes are evident in our area we see the effects where we live now and they are increasing</i> • <i>The Tonga setting is not ready to deal with new disasters due to a lack of resources.</i> • <i>Location over tectonic plates and geography, climate change</i> • <i>Low lying lands in Oceania, coastal populations, limited or no warning systems, tolerance to political corruption or lack of demonstrable democratic process, religious extremism, lack of public awareness of risks.</i> 	<p>The geography and location of Oceania is a factor related to its natural risk profile (Cyclone and earthquake events are seen as contemporary disaster risks in Oceania). Cyclone identified as a current or emerging threat in 18 instances Q1/Q2. Earthquake identified as a current or emerging threat in 21 instances Q1/Q2</p>
<ul style="list-style-type: none"> • <i>Manmade causes/manmade impacts on planetary health,</i> 	<p>Human impact is viewed as a driver of current and emerging risk in Oceania (climate change, population health/</p>

<ul style="list-style-type: none"> • <i>Human development and its imbalance with nature</i> • <i>Poor dietary regulation and management.</i> • <i>Nature, human impact and its influence on the environment, increasing westernisation in islands (more cars = more accidents)</i> • <i>Human attitude and human activity causing climate change and geographic factors, decreased preparedness. People aren't placing importance on preparedness because they haven't seen a disaster</i> • <i>Public health infrastructure or lack thereof, Oceania neighbours have decreased levels of public health infrastructure to mitigate and/or protect, changing/growing populations in disaster prone areas.</i> 	<p>chronic disease and manmade events (terrorism, poverty, unplanned urbanisation) are seen as contemporary risks)</p>
<ul style="list-style-type: none"> • <i>Society is fracturing, some states are investing in religious extremism.</i> • <i>Analyse the impacts of the hazards identified in Q1 vs. continued examination of existing public health data sets. A lack of data has led to this situation, older public health rates are not sensitive to new emerging risks.</i> • <i>Global travel and increasing size and density of populations makes spread of disease easier.</i> • <i>Weather, decreasing natural resources, affluent society have high expectations that may not be met post impact. Sense of community has reduced over years particularly in big cities. In condensed areas there is an increased risk of disruption to basic needs.</i> 	<p>Perceptions of a changing world are considered to be related to perceived risks (climate change) climate change is a consistent theme throughout interviews</p>

<ul style="list-style-type: none"> • <i>Lack of government will alter current human impact trajectory.</i> • <i>Population growth and movement, lack of government strategy and planning to manage this effectively, government corruption</i> • <i>Government of the day not seeing them as a high priority in terms of mitigation due to cost</i> • <i>Poor public health governance at a leadership level</i> 	<p>Political will and poor governance are viewed as a driver of risk</p>
<ul style="list-style-type: none"> • <i>The location of Oceania lends itself to these risks. What's reported seems to indicate that they are escalating in size and population numbers are increasing therefore the footprint is increasing. Infection management processes are poor (antibiotic usage). Political unrest and increased global travel, political impact is increased due to increased media coverage.</i> • <i>Community risk is contextual to the community lens of what is of value in reference to their culture and needs.</i> • <i>We cannot risk assess without asking/involving communities to understand the context of the risk, a hazard impact for one is business as usual for another.</i> 	<p>Risk is contextual to time, place and person</p>
<ul style="list-style-type: none"> • <i>Oceania is the canary in the coal mine of emerging disaster risk, there is a lack of political attention to Oceania impacts from overseas countries, what's happening in the Pacific is due to the effects of countries far away.</i> • <i>I'm not sure.</i> • <i>I don't know if our plans are there</i> 	<p>Inconsistent belief that disaster risk plans and practices are not suited to the future Disaster risks. There is a disconnect between the end user (community) and the developer (government). 12 responses 'no'; 7 responses 'yes', remainder unknown/variable.</p>

<ul style="list-style-type: none"> • <i>They are extremely variable across regions which is a major issue</i> • <i>The threshold in the Pacific islands has been exceeded, we need plans for immigration and attempts to engage countries to organise future land for peoples</i> • <i>We need to recognise that these events are huge challenges and will affect many people's lives therefore plans need to strengthen. We continue to create risks around the world that put people's lives at risk. Understanding what makes people more vulnerable is not well done. The PPRR model doesn't deliver enough however the issue is more about the various functions within society that can manage the risk more effectively. Current plans do not reflect the social and political functions within society that influence actions</i> • <i>They are very distant from the end user and are not practically tailored</i> 	
<ul style="list-style-type: none"> • <i>We are not preparing well, we are not emphasising primary care prevention, lack of funding for implementation and ongoing sustainability</i> • <i>Greater community engagement in plan and practice development in how they're written or described.</i> • <i>They require greater community engagement in planning</i> • <i>They need to be updated to contemporary risk status; current plans are under civil defence where there is a lack of funding</i> • <i>Plans need to be living documents, not just let on the shelf for annual review.</i> 	<p>Increased education of risk and risk assessment at a local level is recommended to develop downstream activities with upstream commitment and enhance community connection with risk ownership, leadership and action</p>

<p><i>The creation of networks supports plan application</i></p> <ul style="list-style-type: none"> • <i>Have clear simple plans that are well practiced, ensure adequate insurance, target kids in schools as an audience</i> • <i>Investment at a political level that leads to funds that drive the process.</i> 	
<ul style="list-style-type: none"> • <i>Do them well to begin with, have more training in risk assessment at local levels to understand hazards.</i> • <i>Think about risk from a positive standpoint: risk awareness can lead to greater investment in the protection of health infrastructure and therefore improved health outcomes. Investigate capacities then vulnerabilities, hazards only give context – therefore increase investment in capacity and vulnerability assessment to inform risk status. Risk assessments need to inform priorities in a country.</i> • <i>Intervene at every level in government, improve population health literacy. Improve health promotion skills of health clinicians, Improve access to care</i> • <i>Local capacity building, expertise is brought in but not always building sustainable solutions or developing local leaders. Focussing on basic not complex solutions as they are easier to achieve and maintain</i> • <i>The government must be the leader of the activity as they have the greatest resources</i> • <i>Senior people need to understand and emphasis preparedness, preparing resources (human, financial, training)</i> 	<p>Improvement requires a people centric approach that is supported at all levels.</p>

<ul style="list-style-type: none"> • <i>Ensuring that information is accessible to people who are impacted</i> • <i>Understand local risks and plan for them, test capacities</i> • <i>Putting the right tools and resources into local systems to better manage their own risk.</i> • <i>Locally driven plans, engagement with scientists on measuring hazards and impacts and creating good communication between groups. Financing is required to develop better disaster risk assessment.</i> 	
---	--

Phase Three

The following generated codes were assessed for theme generation:

1. Climate change is viewed as a contemporary and emerging disaster risk in Oceania. Climate change identified as a current or emerging threat in 21 instances Q1/Q2
2. The geography and location of Oceania is a factor related to its natural risk profile (Cyclone and earthquake events are seen as contemporary disaster risks in Oceania). Cyclone identified as a current or emerging threat in 18 instances Q1/Q2. Earthquake identified as a current or emerging threat in 21 instances Q1/Q2
3. Human impact is viewed as a driver of current and emerging risk in Oceania (climate change, population health/ chronic disease and man-made events (terrorism, poverty, unplanned urbanisation) are seen as contemporary risks)
4. Perceptions of a changing world are considered to be related to perceived risks (climate change) climate change is a consistent theme throughout interviews
5. Political will and poor governance are viewed as a drivers of risk
6. Risk is contextual to time, place and person
7. Inconsistent belief that disaster risk plans and practices are not suited to the future Disaster risks. There is a disconnect between the end user (community) and the developer (government). 12 responses 'no'; 7 responses 'yes', remainder unknown/variable.
8. Increased education and education of risk and risk assessment at a local level is recommended to develop downstream activities with upstream commitment and enhance community connection with risk ownership, leadership and action
9. Improvement requires a people centric approach that is supported at all levels.

Using the Braun and Clark methodology where a theme “captures something important about the data in relation to the research question, and represents some level of patterned response or meaning within the data set”[71], the codes were reviewed to identify similarity

or overlap and whether unification of codes into central themes or sub themes was appropriate. Exploration of risk within interviewee responses demonstrated a pattern of context relative to the Oceania region; codes 1 and 6 and the findings from interview question one were collapsed to as a theme of risk perception. Many responses clustered around human development, human health and human impact internal and external to Oceania as influencing factors on disaster risk (codes 3 and 4); these codes were unified as a singular theme. There was inconsistent response to the utility of disaster plans (code 7), perceived gap between planners, actors and leaders (code 5) and themes identified in answers to question two identified lack of political leadership and poor governance associated with events of internal conflict, migration and extremism. A singular theme of planning and governance was derived from these codes. Local education, community engagement and leadership support (codes 8 and 9) were identified as drivers of change and formed as a theme. The final five themes developed were:

1. Climate change is viewed as a contemporary and emerging disaster risk in Oceania.
2. The geography and location of Oceania is a factor related to its natural risk profile which is perceived to be the greatest contemporary and emerging threat in Oceania. Risk is contextual to place and person.
3. Human development and impact are viewed as drivers of current and emerging risk in Oceania. Perceptions of a changing world are considered to be related to perceived risks.
4. Current disaster risk plans and practices are not suited to the future Disaster risks. There is a perceived disconnect between the end user (community) and the developer (government). Lack of political will and poor governance are viewed as barriers to improvement.
5. Increased education and education of risk and risk assessment at a local level is recommended to develop downstream activities with upstream commitment and enhance community connection with risk ownership, leadership and action. Improvement requires a people centric approach that is supported at all levels.

The five developed themes with illustrated quotes are shown in Phase 4 table 3.

Phase Four

Table 3: Five themes developed from seven codes with illustrative data extracts (direct quotes)

Climate change is viewed as a contemporary and emerging disaster risk in Oceania	The geography and location of Oceania is a factor related to its natural risk profile which is perceived to be the greatest contemporary and emerging threat in Oceania. Risk is contextual to place and person	Human development and impact are viewed as drivers of current and emerging risk in Oceania. Perceptions of a changing world are considered to be related to perceived risks	Current disaster risk plans and practices are not suited to the future Disaster risks. There is a perceived disconnect between the end user (community) and the developer (government). Lack of political will and poor governance are viewed as barriers to improvement	Increased education and education of risk and risk assessment at a local level is recommended to develop downstream activities with upstream commitment and enhance community connection with risk ownership, leadership and action. Improvement requires a people centric approach that is supported at all levels.
<i>Climate change, lack of water, heat related injuries/consequences, cyclones and natural disasters increasing in severity.</i> <i>Climate change, diseases, trans-nation migration</i>	<i>Urbanisation/industrialisation with population growth, climate issues in island areas and loss of land mass, new/mutated diseases.</i> <i>Public health issues, novel virus strains in poorer nations due to frequent travel in the</i>	<i>Manmade causes/manmade impacts on planetary health</i> <i>Human development and its imbalance with nature</i> <i>Poor dietary regulation and management.</i>	<i>Oceania is the canary in the coal mine of emerging disaster risk, there is a lack of political attention to Oceania impacts from overseas countries, what's happening in the Pacific is due to the effects of countries far away.</i>	<i>We are not preparing well, we are not emphasising primary care prevention, lack of funding for implementation and ongoing sustainability</i> <i>Greater community engagement in plan and practice development in how they're written or described.</i>

<p><i>due to climate change.</i></p> <p><i>Increasing global warming influencing natural disaster risk</i></p> <p><i>Populations are vulnerable to emerging risks; overall vulnerability is increasing due to climate change with more hot days and less cool days.</i></p> <p><i>Climate change – its impact on livelihood and health.</i></p> <p><i>Climate change, lack of ability of communities to cope with impact</i></p>	<p><i>region. Terrorism and bio attack and/or terrorism hazards by polluting food and/or water. Bushfire.</i></p> <p><i>The changes are evident in our area we see the effects where we live now and they are increasing</i></p> <p><i>The Tonga setting is not ready to deal with new disasters due to a lack of resources.</i></p> <p><i>Location over tectonic plates and geography, climate change</i></p> <p><i>Low lying lands in Oceania, coastal populations</i></p> <p><i>The location of Oceania lends itself to these risks. What's reported seems to indicate that they are</i></p>	<p><i>Nature, human impact and its influence on the environment, increasing westernisation in islands (more cars = more accidents)</i></p> <p><i>Human attitude and human activity causing climate change and geographic factors, decreased preparedness. People aren't placing importance on preparedness because they haven't seen a disaster</i></p> <p><i>Public health infrastructure or lack thereof, Oceania neighbours have decreased levels of public health infrastructure to</i></p>	<p><i>Lack of government will to alter current human impact trajectory.</i></p> <p><i>I'm not sure.</i></p> <p><i>I don't know if our plans are there</i></p> <p><i>They are extremely variable across regions which is a major issue</i></p> <p><i>The threshold in the Pacific islands has been exceeded, we need plans for immigration and attempts to engage countries to organise future land for peoples</i></p> <p><i>We need to recognise that these events are huge challenges and will affect many people's lives therefore plans need to strengthen. We continue to create risks around the world that put people's lives at risk.</i></p>	<p><i>They require greater community engagement in planning</i></p> <p><i>They need to be updated to contemporary risk status; current plans are under civil defence where there is a lack of funding</i></p> <p><i>Plans need to be living documents, not just let on the shelf for annual review. The creation of networks supports plan application</i></p> <p><i>Have clear simple plans that are well practiced, ensure adequate insurance, target kids in schools as an audience</i></p> <p><i>Investment at a political level that leads to funds that drive the process.</i></p> <p><i>Do them well to begin with, have more training in risk assessment at local levels to understand hazards.</i></p>
--	---	---	---	---

	<p><i>escalating in size and population numbers are increasing therefore the footprint is increasing.</i></p> <p><i>Infection management processes are poor (antibiotic usage).</i></p> <p><i>Political unrest and increased global travel, political impact is increased due to increased media coverage.</i></p> <p><i>Community risk is contextual to the community lens of what is of value in reference to their culture and needs.</i></p> <p><i>We cannot risk assess without asking/involving communities to understand the context of the risk, a</i></p>	<p><i>mitigate and/or protect, changing/growing populations in disaster prone areas.</i></p> <p><i>Society is fracturing, some states are investing in religious extremism.</i></p> <p><i>Analyse the impacts of the hazards identified in Q1 vs. continued examination of existing public health data sets. A lack of data has led to this situation, older public health rates are not sensitive to new emerging risks.</i></p> <p><i>Global travel and increasing size and density of populations makes spread of disease easier.</i></p>	<p><i>Understanding what makes people more vulnerable is not well done. The PPRR model doesn't deliver enough however the issue is more about the various functions within society that can manage the risk more effectively. Current plans do not reflect the social and political functions within society that influence actions</i></p> <p><i>They are very distant from the end user and are not practically tailored</i></p>	<p><i>Think about risk from a positive standpoint: risk awareness can lead to greater investment in the protection of health infrastructure and therefore improved health outcomes. Investigate capacities then vulnerabilities, hazards only give context – therefore increase investment in capacity and vulnerability assessment to inform risk status. Risk assessments need to inform priorities in a country.</i></p> <p><i>Intervene at every level in government, improve population health literacy. Improve health promotion skills of health clinicians, Improve access to care</i></p> <p><i>Local capacity building, expertise is brought in but not always building sustainable solutions or developing local leaders.</i></p>
--	--	--	--	--

	<p><i>hazard impact for one is business as usual for another.</i></p>	<p><i>Weather, decreasing natural resources, affluent society have high expectations that may not be met post impact. Sense of community has reduced over years particularly in big cities. In condensed areas there is an increased risk of disruption to basic needs.</i></p>		<p><i>Focussing on basic not complex solutions as they are easier to achieve and maintain</i></p> <p><i>The government must be the leader of the activity as they have the greatest resources</i></p> <p><i>Senior people need to understand and emphasis preparedness, preparing resources (human, financial, training)</i></p> <p><i>Ensuring that information is accessible to people who are impacted</i></p> <p><i>Understand local risks and plan for them, test capacities</i></p> <p><i>Putting the right tools and resources into local systems to better manage their own risk.</i></p> <p><i>Locally driven plans, engagement with scientists on measuring hazards and impacts and creating good</i></p>
--	---	---	--	---

				<i>communication between groups. Financing is required to develop better disaster risk assessment.</i>
--	--	--	--	--

5.6.3 Discussion

This chapter described the qualitative data analysis undertaken to understand perceptions of current and emerging disaster risk in Oceania. This data is further considered and discussed in the next chapter inclusive of a peer reviewed paper.

5.7 STUDY 1: PERCEPTIONS OF DISASTER RISK IN OCEANIA

5.7.1 Introduction

The aim of the study was to investigate emerging disaster risk that threaten the health and wellbeing of societies associated with disaster impact. Emerging disaster risks are poorly understood. Without clear evidence readiness to accept future threats is low resulting in delayed strategic planning for adaptation or response. The role of the analysis was to examine what emerging disaster risk evidence exists to support decision making and profile the nature, type and potential human and economic impact of emerging disaster risk.

5.7.2 Current and Emerging Disaster Risks Perceptions in Oceania: Key Stakeholders Recommendations for Disaster Management and Resilience Building.

5.7.2.1 Introduction

This peer reviewed published paper synthesised the outcomes of study 1 to provide key findings related to disaster risk perception in Oceania. This paper contributed to the knowledge base by raising awareness of the need for forecast and horizon scanning for future disasters and the limitations of existing disaster risk profiling.

5.7.2.2 Peer reviewed published paper: Current and Emerging Disaster Risks Perceptions in Oceania: Key Stakeholders Recommendations for Disaster Management and Resilience Building.



Article

Current and Emerging Disaster Risks Perceptions in Oceania: Key Stakeholders Recommendations for Disaster Management and Resilience Building

Joseph Cuthbertson ^{1,*}, Jose M. Rodriguez-Llanes ² , Andrew Robertson ³ and Frank Archer ¹

¹ Disaster Resilience Initiative, Accident Research Centre, Clayton, Monash University, Melbourne 3800, Australia; Frank.Archer@monash.edu

² European Commission, Joint Research Centre (JRC), 21027 Ispra, Italy; jose-manuel.rodriguez-llanes@ec.europa.eu

³ Western Australia Department of Health, East Perth, WA 6004, Australia; Andrew.Robertson@health.wa.gov.au

* Correspondence: Joseph.Cuthbertson@monash.edu.au; Tel.: +61-438-730-064

Received: 21 November 2018; Accepted: 23 January 2019; Published: 5 February 2019



Abstract: Identification and profiling of current and emerging disaster risks is essential to inform effective disaster risk management practice. Without clear evidence, readiness to accept future threats is low, resulting in decreased ability to detect and anticipate these new threats. A consequential decreased strategic planning for mitigation, adaptation or response results in a lowered resilience capacity. This study aimed to investigate threats to the health and well-being of societies associated with disaster impact in Oceania. The study used a mixed methods approach to profile current and emerging disaster risks in selected countries of Oceania, including small and larger islands. Quantitative analysis of the International Disaster Database (EM-DAT) provided historical background on disaster impact in Oceania from 2000 to 2018. The profile of recorded events was analyzed to describe the current burden of disasters in the Oceania region. A total of 30 key informant interviews with practitioners, policy managers or academics in disaster management in the Oceania region provided first-hand insights into their perceptions of current and emerging threats, and identified opportunities to enhance disaster risk management practice and resilience in Oceania. Qualitative methods were used to analyze these key informant interviews. Using thematic analysis, we identified emerging disaster risk evidence from the data and explored new pathways to support decision-making on resilience building and disaster management. We characterized perceptions of the nature and type of contemporary and emerging disaster risk with potential impacts in Oceania. The study findings captured not only traditional and contemporary risks, such as climate change, but also less obvious ones, such as plastic pollution, rising inequality, uncontrolled urbanization, and food and water insecurity, which were perceived as contributors to current and/or future crises, or as crises themselves. The findings provided insights into how to improve disaster management more effectively, mainly through bottom-up approaches and education to increase risk-ownership and community action, enhanced political will, good governance practices and support of a people-centric approach.

Keywords: disaster risk; Oceania; emerging risk; health threat; resilience; non-traditional

1. Introduction

Disaster risk reduction is a holistic approach to long-term community and state development that unifies preparation and mitigation practices. Its function has been described as “lying between the interface of humanitarian response to disasters and developmental programs [1].” Traditional emergency management-based frameworks employ hazard and risk analysis in the development of prevention, preparedness, response and recovery plans. This analysis is invariably based on historical data of event

impact. Flage and Aven explored definitions of emerging risk and described a knowledge-based definition where emerging risk is “related to an activity when the background knowledge is weak but contains indications/justified beliefs that a new type of event (new in the context of that activity) could occur in the future and potentially have severe consequences to something humans value” [2].

The scale, frequency and type of disasters are changing globally [3]. Academic and humanitarian institutions engaged in disaster-related science have identified new and emerging health threats to populations [4]. These threats have been described as underlying drivers that increase the frequency, complexity and severity of disasters. Described underlying drivers include poverty, climate change, poor governance, ecosystem decline, rapid urbanization and population growth [3]. These underlying drivers have yet to be clearly defined either in terms of scope and to what extent they aggravate the impact of a disaster. Moreover, it is unclear whether some of these aggravating factors might be considered as new or emerging, and as yet unclassified, disasters. Existing disaster databases that rely on pre-determined definitions, thresholds and data reporting systems, are not always sensitive to these changes and may not readily identify new or non-traditional health threats. The emergence of new, unexpected, non-traditional threats and disaster types, and the re-emergence of former health risks, has received less attention in the literature and requires broader and diverse approaches to the investigation of future disaster threats to population health [5]. Identifying emerging risks to health in Oceania and understanding the context of disaster risk through the perceptions of relevant stakeholders working with the at-risk population provides an opportunity to inform perceptions on emerging risks and consider appropriate disaster risk management strategies.

A comprehensive approach to reduce disaster risk was mandated in the United Nations-endorsed Sendai Framework for Disaster Risk Reduction, whose declaration was “to enhance efforts to strengthen disaster risk reduction and to reduce disaster losses of lives and assets from disasters worldwide” [6]. The Sendai Framework for Disaster Risk Reduction recognizes the need for improved assessment of emerging disaster risk with a specific call to “academia, scientific and research entities and networks to focus on the disaster risk factors and scenarios, including emerging disaster risks, in the medium and long term” [6]. Small island states are specifically identified by the Sendai Framework for action with a call for “particular attention” to their higher vulnerability and risk [6,7].

Utilizing the Sendai Framework lens of applying a “comprehensive approach” to disaster risk reduction, this study examined perceptions of current and future disaster risks in Oceania and contrasted them to reported, classified disaster impacts. Our investigation is reflective of the Sendai Framework by increasing research for regional, national and local application, supporting the interface between policy and science for decision-making and describing risk priorities [6]. We sought to delineate priority areas for action relative to emerging disaster risk. This study addresses the research question “do knowledge gaps exist between what disaster risks are measured in Oceania and what disaster risks are perceived to be of threat by experts within the region?”

2. Materials and Methods

The study used a mixed methods approach. The definition of Oceania for this research was applied according to the United Nations Statistical Division methodology. Quantitative data on the natural and technological disaster impact in Oceania from 2000 to 2018 was extracted from The Centre for Research on the Epidemiology of Disasters (CRED) Emergency Events Database (EM-DAT) [8]. The EM-DAT, a free, publicly accessible web-based resource, contains essential core data on the occurrence and effects of over 22,000 mass disasters in the world from 1900 to the present day. The criteria for EM-DAT database entry of a reported disaster is ten or more people reported killed, or one hundred or more people reported affected, or declaration of a state of emergency or a call for international assistance. The EM-DAT data includes: Disaster number, country or countries in which the disaster has occurred, disaster group, disaster type, date, number of deaths, number of people injured, number of people homeless, number of people affected, and estimated damage [8].

Qualitative data was collected through key informant semi-structured interviews. Interview questions are included in Appendix A. Using convenience sampling, thirty-five interviews, contacted by email or face-to-face, were requested. Of these, 30 accepted to be interviewed while the remaining 5 did not respond to the email request. All of the participants were engaged in disaster management in the Oceania region as researchers, practitioners in emergency management or disaster healthcare, policy managers or academics and were identified through existing disaster management professional networks within the region. Thirty individual interviews with participants from 9 different countries were conducted face to face ($n = 19$) or by telephone call ($n = 11$). Data collection was conducted between April and November 2017, and a typical interview lasted between 45 and 60 minutes. Interviews were recorded and ceased when responses indicated that no new information was obtained. The Hazard and Peril Glossary for describing and categorizing disasters applied by CRED [8] guided thematic analysis of interview questions one and two (Appendix A). Comparison of individual responses to questions 1 and 2 (Appendix A) to the reported pattern of disasters in country of the respondents' location in Oceania (Tables 2 and 3) was conducted to identify differences in perceived current and emerging disaster risks compared to reported events. Qualitative analysis of the remaining interview questions used narrative inquiry according to the six-step process described by Braun et al. [9]. Interviewee responses were analyzed using the thematic analysis where a theme “captures something important about the data in relation to the research question, and represents some level of patterned response or meaning within the dataset” [9]. Developed themes were reviewed to identify similarity or overlap and whether unification into central themes or sub themes was appropriate.

Ethical Considerations

All respondents provided written, informed consent prior to participation, provided by scanned version or picture by e-mail, and did not receive any incentives to participate in the study. Ethical approval was obtained from Monash University Human Research Ethics Committee (HREC 7539). Recordings were stored safely and kept confidential as per The Australian Code for the Responsible Conduct of Research, and the Monash University HREC Guidelines.

3. Results

The demographic profile of interviewees for the analyzed sample (Table 1) showed similar proportions across gender, slightly favoring females. The response rate from Australian interviewees (60%) was large; however, interviewees from 6 countries in Oceania participated in the study. Practitioners in emergency management or disaster healthcare were the predominant profession interviewed. Three participants were located outside of Oceania (Indonesia, Geneva); however, their experience and knowledge of disaster risk reduction in the region provided a valuable contribution.

Table 1. Participant demographics.

Characteristics	No. (%)
<i>Gender</i>	
Male	14 (46%)
Female	16 (53%)
<i>Country</i>	
Australia	18 (60%)
New Zealand	2 (6%)
Indonesia	2 (6%)
Timor Leste	2 (6%)
Fiji	2 (6%)
Tonga	2 (6%)
Hawaii	1 (3%)
Geneva	1 (3%)
<i>Profession</i>	
Academic	5 (16%)
Practitioner (emergency management or disaster healthcare)	23 (76%)
Manager	2 (6%)

3.1. Reviewing Potential Themes

Initial findings from interview question one (Appendix A) were developed into a theme (1) of perceived climate change risk (Box 1). Exploration of risk within interviewee responses demonstrated varying contexts relative to the interviewees' location in the Oceania region; this contextual risk perception was developed as theme 2. Many responses clustered around human development, human health and human impact, both internal and external to Oceania, as factors influencing disaster risk, which was unified as a singular theme (theme 3). There was inconsistent response to the utility of disaster plans, with a perceived gap between planners, actors and leaders, and themes identified in answers to question two, which recognized a lack of political leadership and poor governance associated with events of internal conflict, migration and extremism. A singular theme of planning and governance was derived from these findings (theme 4). Local education, community engagement and leadership support were identified as drivers of change and formed theme 5. The final five themes resulting from our analysis are presented in Box 1.

Box 1. Final five themes identified in this study.

- | |
|--|
| <ol style="list-style-type: none"> 1. Climate change is observed as a contemporary and emerging disaster risk in Oceania. 2. Risk is contextual to the different countries, communities and individuals in Oceania. 3. Human development trajectories and their impact, along with perceptions of a changing world, are viewed as drivers of current and emerging risks. 4. Current disaster risk plans and practices are not suited to the future disaster risks: Reconnect end users (community) and developers (government). Enhanced political will and good governance are key. 5. Increased education and education of risk and risk assessment at a local level to empower community risk ownership. leadership and action: A people-centric approach. |
|--|

Theme 1: Climate change is observed as a contemporary and emerging disaster risk in Oceania.

Respondents across Oceania reported climate change as a top current (and future) disaster risk. How climate change was described as a risk or a hazard varied between participants. Sea-level rise was identified twice as a current risk, both times by residents of the Pacific Islands, who, along with other respondents, also reported concerns of increased sea transportation accidents due to rising sea levels and trans-national migration in island areas due to loss of habitable area [Respondent 8, New Zealand; Respondent 28, Hawaii; Respondent 6, Tonga]. Current climate change risk was also identified in association with disease "*Climate related infectious disease/pandemic*" [Respondent 11]. Overall, participants who viewed climate change as a risk or hazard described a breadth of impacts related to it, including "*Increasing global warming influencing natural disaster risk*" [Respondent 18] and "*Climate change, lack of water, heat related injuries/consequences, cyclones and natural disasters increasing in severity*" [Respondent 7]. Whereas some respondents highlighted a relationship between climate change and disaster risk, other participants described additional health threats and vulnerabilities associated with climate change. Responses included: "*Climate change—its impact on livelihood and health*" [Respondent 22], "*Climate change, lack of ability of communities to cope with impact*" [Respondent 5], "*Climate change, diseases, trans-nation migration due to climate change*" [Respondent 8, New Zealand].

Theme 2: Risk is contextual to the different countries, communities and individuals in Oceania.

The geography and location of Oceania is a factor related to its natural risk profile and was consistently reported by interviewees as a significant contemporary and emerging threat in Oceania. Risk is contextual to place and person in Oceania; in particular, respondents noted cyclone and earthquake events as high disaster risks in Oceania. Cyclone was identified as a current or emerging threat in 18 instances, whereas earthquake was identified as a current or emerging threat in 21 instances. An international emergency response health practitioner related natural hazards and risk in Oceania,

“the location of Oceania lends itself to these risks” [Respondent 28, Hawaii]. Furthermore, there was a reported sense of a lack of health security to protect communities. In particular, *“Oceania neighbours have decreased levels of public health infrastructure to mitigate and/or protect against the impacts of disasters”* [Respondent 18, Australia], and they also argued that population growth is an influencing factor: *“What’s reported seems to indicate that they (disasters) are escalating in size and population numbers are increasing therefore the footprint is increasing”* [Respondent 18, Australia]. Interviewees across all countries expect natural disasters to decrease and disease events to remain relatively steady. This was an unusual finding, given that the frequency and severity of natural disasters is expected to rise and the risk profile of Oceania is high, due to the presence of tectonic fault lines and seasonal cyclone and drought patterns [10].

Theme 3: Human development trajectories and their impact, along with perceptions of a changing world, are viewed as drivers of current and emerging risk.

Human development trajectories and their impact are viewed as drivers of current and emerging risk in Oceania. Perceptions of a changing world are considered to be related to perceived risks. Population growth and changes in population demographics, transport, technology and human security, the effect of urbanization and the impact of human development on the environment, including biodiversity loss and pollution, were viewed as current and emerging risks in Oceania by respondents.

Perceptions of disaster risk associated with conflict were not constrained to acts of terrorism, although terrorism was viewed predominantly as a current rather than future disaster risk. Impacts of events due to conflict and crime, including cyber-attacks and technology security, criminals acting under the banner of terrorism, unexpected behavior of individuals/violence, and civil unrest, featured as current and future reported risks. Of these, one respondent noted that events such as *“terrorism and infectious disease are global/intercontinental risks that seem to be media exposed rather than public health exposed”* [Respondent 10, New Zealand].

The impact of urbanization was considered to be a current and future driver of disaster risk. In particular, food, water and energy security due to unplanned population growth or growth that exceeded infrastructure capacity, were identified. Additionally, unrealistic expectations of improved living standards were reported as urban-related hazards that increase disaster risk. Several respondents identified *“increasing demand exceeding infrastructure, unsustainable capacity to respond adequately to emerging threats, human development and its imbalance with nature, and affluent society having high expectations that may not be met post impact of a disaster”* [Respondents 12, 19] as drivers of disaster. Respondent 1 reported that *“within urban settings a sense of community has reduced over years particularly in big cities. In condensed areas there is an increased risk of disruption to basic needs”* [Respondent 1]. A new risk of plastic pollution was reported as a current and emerging disaster risk by the same respondent [Respondent 1, Australia].

Additional emerging non-traditional disaster risks associated with transport identified by respondents included fossil-fuel dependence for transport of goods, political risk from migration, transportation need increasing due to rising sea levels, road traffic incidents in Pacific Island Nations due to increased westernization of the population, and novel microbial infections in poorer nations due to frequent travel in the region.

Human development was considered to be an underpinning driver of new disasters in Oceania.

Theme 4: Current disaster risk plans and practices are not suited to the future disaster risks: Reconnect end users (community) and developers (government). Enhanced political will and good governance are key.

Current disaster risk plans and practices are not considered suited to the future disaster risks. Moreover, there is a perceived disconnect between the end user (community) and the developer (government). Lack of political will and poor governance are viewed as barriers to improvement. Respondents did not demonstrate a strong belief that disaster risk plans and practices are suited to the

future disaster risks. Only eight of thirty respondents felt that current disaster risk plans and practices are suited to the future disaster risks. A further eight were unsure and one respondent felt that *“They are extremely variable across regions which is a major issue, more theoretical than practical”* [Respondent 5].

A lack of trust and belief in government were expressed by 14 respondents. Given the high proportion of Australian respondents, further examination of the context of trust and governance in this country is worthy of further exploration. Other reports of *“government corruption, political disasters, political unrest, lack of government strategy and planning to manage this effectively, and rogue political states”* [Respondent 24, Indonesia] were used as descriptors of barriers to improvement.

Investment in activities that enhance disaster-risk reduction require long-term political vision and will to enable policy and planning that increases security at an individual, community and national level over time. Such decisions can be challenging where political systems lack strength to enable and commit to long-term sustainable development.

Theme 5: Increased education and education of risk and risk assessment at a local level to empower community risk ownership, leadership and action: A people-centric approach.

Community-based action was a common response as a solution to improve disaster-risk reduction. Achieving action in this area included suggestions of training and education related to understanding and owning risk at an individual and community level *“Putting the right tools and resources into local systems to better manage their own risk”* [Respondent 23]. Linkage between theme four and theme five was evident as respondents reported the need for leadership and governmental support in achieving these actions.

A people-centred approach was evident in respondent suggestions. Key responses noted areas for improvement of disaster practice that can enhance future community resilience to disaster risk. These included: *“Ensuring grassroots training on preparedness and response on the disaster risks that are relevant to those communities. Providing training to communities and ensuring plans are local and relevant; training people to self-respond, build self-awareness into communities to have initial plans at the time of need. Lessons learnt need to be applied and practiced; engaging communities, finding ways for communities to be further involved/integrated into disaster management. Minimise top down, maximise bottom up strategies. Resource communities to understand and adopt good risk assessment practices. Every community needs to own risk management strategy that is updated regularly with new and evolving knowledge. Urban planning needs disaster risk strategies built into them with detail. Then communicate these actions into the local population. Improve connectedness in communities, and knowing people and groups within them—this should be a function of disaster practice that creates trusted networks. The decision makers are still tied to response. There is a need to look at prevention with greater strength and engagement. We need to make sure that everyone within the health system has a role to play in managing disaster risk so that when ‘controls’ are overrun we transition into emergency mode. This would mean managing risk at all times—society in general does this, when vigilance drops things happen.”* [Respondent 11]. The emphasis on enabling ownership of disaster risk at an individual and community level was common amongst all respondents. The provision of guidance, information, and access to services that incorporate and build on social norms and cultural practices were suggested to improve program integration and enable informed decision-making by citizens.

Increased education of risk and risk assessment at a local level is recommended to develop downstream activities with upstream commitment and enhance community connection with risk ownership, leadership and action. Improvement requires a people-centric approach that is supported at all levels.

3.2. Quantitative Results

The Emergency Events Database defines Oceania according to the United Nations Statistical Division methodology. The EM-DAT reporting of natural disasters data classified according to the Hazard and Peril Glossary [11] in countries of the respondents location in Oceania in 2000–2018 was extracted from EM-DAT (Tables 2 and 3) [8].

Table 2. Natural disasters of study countries in Oceania 2000–2018 [8].

Country/Natural Disaster	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Grand Total
Australia	6	9	5	11	7	4	8	2	5	6	8	1	2	2	2	7			1	86
Drought			1				1												1	3
Epidemic				1																1
Extreme temperature										1					1					2
Flood	1	4		4	3	1	1	1	4	2	5	1	2							29
Insect infestation	1				1															2
Storm	3	3	3	5	3	2	3	1	1	2	3				1	4				34
Wildfire	1	2	1	1		1	3			1				2		3				15
Fiji	1	1		1	2	1	2	4	1	2	1		3			1				20
Drought																1				1
Flood	1				1	1	1	2		1			2							9
Storm		1		1	1		1	2	1	1	1		1							10
New Zealand	2	1	1	2	2	2	1	1						3			2	1		18
Drought														1						1
Earthquake														1			1			2
Epidemic				1																1
Extreme temperature		1																		1
Flood	1		1		2	1	1										1			7
Storm	1			1		1		1						1				1		6
Tonga		1			1					1		1			1		3			8
Earthquake										1										1
Storm		1			1							1			1		3			7

Table 3. Technological disasters in study countries in Oceania 2000–2018 [8].

Country/Natural Disaster	2000	2003	2004	2005	2007	2009	2010	2011	2012	2013	2016	Grand Total
Australia	2		1	1	1	1	1	1	1	1		10
Air				1								1
Fire	1							1				2
Rail			1		1							2
Water	1					1	1		1	1		5
New Zealand		1					2	1	1			5
Air									1			1
Explosion							1					1
Other								1				1
Water		1					1					2
Tonga						1						1
Water						1						1

The EM-DAT data demonstrate storm events occurring in all countries reported, and this event was the highest natural disaster event type across the date range in all countries except New Zealand. Climate change is not included within the framework of disaster classification applied by EM-DAT; however, CRED does recognize climate change as an ‘exacerbating factor’ of classified disasters. The quantitative data of natural disasters in Oceania from EM-DAT did not indicate any change in rates of disasters considered to be associated with climate change (drought, storm, flood, extreme temperature).

Water-related transport disaster events occurred in all countries reported and were the highest transport-related disaster for all countries.

Australia reported the highest volume of natural and technological disaster events across the date range.

The findings of question one and two of the interviews were classified using the same methodology applied by EM-DAT [11]. When comparing the responses to question 1 of interviewees with the EM-DAT data, there are similarities in the natural hazard profile of storm, flood and earthquake and the technological hazard profile of transport accidents. When comparing the historical quantitative data in Tables 2 and 3 to the qualitative data of current and future threats reported in questions one and two, there was a demonstrated knowledge gap between perceived and reported disasters.

4. Discussion

This research found that climate change is viewed as a contemporary and emerging disaster risk in Oceania. Reports of climate variability, transportation increasing due to rising sea levels, trans-national migration due to climate change, climate-related disasters, climate issues in island areas and loss of land mass were descriptors applied to describe perceived hazards and impacts due to climate change. These emerging risks are reflective of both the geographical location of countries in Oceania, where decreasing land mass due to rising oceans has been previously reported [12], and climate change-driven migration [13–15]. Climate change was perceived as an individual risk, and as an influencing factor on other risks, by many respondents. Climate change has been broadly associated with migration, conflict and health security by many authors [16–19]. The association between climate change-induced migration, and its relationship to transport accidents at sea, is a unique finding in this research and demonstrates the contextual risk of this hazard in the Pacific. Interviewees from Pacific Island Nations (Fiji, Tonga, Timor Leste) consistently identified natural hydrological hazards as current risks (storm and flooding) and the impacts of climate change as new emerging risks. This finding may be due to geographical positioning and respondents’ sense of health security related to their location and increased local health burden.

The finding of climate change as a current and future cause of disasters is consistent with the Fifth Assessment Report by the Intergovernmental Panel on Climate Change, which focussed on understanding and adapting to extreme events and disasters, predicted to become more frequent under climate change [20]. The Sendai Framework for Disaster Risk Reduction calls for “addressing

climate change as one of the drivers of disaster risk” and suggests that “more dedicated action needs to be focused on tackling underlying disaster risk drivers, such as the consequences of poverty and inequality, climate change and variability” [6]. Moreover, climate change has been described by the Lancet Commission in 2009 as “the biggest global health threat of the 21st century” [21], and, as such, it represents a non-traditional, emerging threat to the health status of communities [22]. The threat that climate change poses as a disaster has been recognized and acted upon by the World Association of Disaster and Emergency Medicine (WADEM), which has issued a position statement and special report to inform and guide members and partners [14,23].

When considering future threats, our response data describing emerging risk in Oceania over the next 10 years (question 2) did not always fit the profile of traditionally reported disaster definitions and trends. A mixed pattern of threats that can act as risk factors or become disasters themselves emerged from the data. The effects of an increasingly urbanized region appear to be evident in the types of contemporary risks reported that are associated with drivers of human impact. Plastic pollution, cyber-insecurity, biodiversity loss, inequitable resource distribution, salinization, infrastructure weaknesses, chronic disease, transport accidents, food, water and energy insecurity, poverty, refugee crises and changing patterns of international migration were captured by the interviews. These findings are notable, as the relationship between increasing urbanization, human development and population growth in respect to pollution, unequal distribution of resources, environmental impact and disaster risk has been previously identified [24]. Monitoring and reporting on planetary health has emerged as a new discipline in academia supported by a topical Lancet journal dedicated to the investigation and monitoring of human impacts and the boundaries of planetary capacity to absorb and adapt to these [25]. The increase in disposable, single-use plastics has been identified as a driver of global plastic pollution requiring whole of government, industry and community action [26,27].

Direct transport accidents are currently classified by EM-DAT as technological disasters (e.g., death or injury as a direct result of transportation incident or event) [11]. In the context of transport-related risk in Oceania, respondents reported that increased road and sea transport, and the need for people to move and travel will increase transport risks. This included road traffic injuries, migration, increased disease risk due to increased ease of global travel, and mass transport accidents in isolated areas, as current and future drivers of transport disasters in Oceania. Whereas some of the reported threats are currently classified as disasters (i.e., transport accidents), other emerging threats are not visible as classified, reported events. As a consequence, many of the perceived emerging risks are not captured in traditional disaster event databases, as they are not viewed or defined as traditional disasters. These unclassified risks or non-traditional health threats are pervasive, as their measurement is not aligned with current disaster events to enable threat analysis. One interviewee reported “*whether society is able to cope with what is happening in respect to an aging population*” [Respondent 25, Australia] as a current risk in Oceania, inferring a sense of change in population and a lack of preparedness for the potential impact of the change. Conflict as a driver of disaster varied in context and included terrorism, unexpected behavior of individuals/violence, cyber-attack, internal conflict, political unrest, migration and extremism. This finding is consistent with contemporary research identifying conflict and terrorism as a public-health problem [28–30].

Reported unclassified risks are expected to continue into the next decade; however, the response rate of some indicated a reduction over time of some perceived threats (21 interviewees reported terrorism-related events as a current risk, 13 reported them as a future risk; 23 interviewees reported urbanization-related events as a current risk, 13 reported them as a future risk). The relationship of such events to natural disasters as either a mitigating or an enhancing effect is unknown, as is the context of these risks in small island states, where size and geography can limit resilience absorptive capacity.

Whereas disaster databases do not capture these unclassified risks or non-traditional health threats, global risk analysis reports have. The World Economic Forum Global Risk Report identified societal fracturing and a loss of trust by communities in government in 2014 [31]. In 2017, inequality has been reported as a key driver of contemporary risk [32]. This finding is reflective of theme four, “a

perceived disconnect between the end user (community) and the developer (government)". Lack of political will and poor governance are viewed as "barriers to improvement"; and the reporting of poverty by respondents as an emerging Oceanic risk.

The identification and development of theme five was based on consistent reporting of a need for community empowerment in improving disaster risk-reduction practice. This finding demonstrates a strong correlation with the World Health Organization's Risk Reduction and Emergency Preparedness Strategy. This strategy has purposefully focused its action at the community level and has described goal of "participation that can measurably reduce future risks and losses" [33].

Oceania was reported as "the canary in the coal mine of emerging disaster risk, there is a lack of political attention to Oceania impacts from overseas countries, what's happening in the Pacific is due to the effects of countries faraway" [Respondent 20]. In consideration of global policies, and statements on the protection of health related to disaster risk, these findings of unclassified risks or non-traditional health threats beg the question of when does an emerging risk, chronic threat or event impact exceed a threshold of social perception that transitions its context and classification as a disaster? Furthermore, is there a greater need to consider how changes in population demographics are used to inform risk assessment?

Solutions recommended by interviewees focussed on improving individual and community risk education, awareness, and ownership. Improvement in community and governmental trust is required to facilitate such action and empower communities to engage in prevention-related strategies that are contextual to their location, capacities and vulnerabilities. As stated by one respondent, "*Communities have to own it. This means a sense of self awareness is required to understand you require a measure of self-reliance*" [Respondent 20].

Limitations

This study sought to understand the profiles of disaster risks in Oceania and the perceptions of emerging disaster risk. This study is limited in that there is not representation from all Oceanic Pacific Islands; additionally, the majority of respondents were predominantly employed in the health sector of disaster management. As a consequence, their views may be more focussed on health outcomes related to disaster impacts based on insights that are related to practical experience in disaster management in Oceania. A predominantly Australian response rate (60%), compared to all other countries accessed in Oceania, may bias the perception of overall responses to a more Australian perspective. The rates of natural disasters in Oceania considered to be related to climate change were considered in this research; however, the impact of such events on any change was not, which is a limitation of this paper.

5. Conclusions

Natural disasters related to the geography and location of countries in Oceania were identified by respondents as significant current and future disaster risks in Oceania. Non-traditional health threats and unclassified risks were an additional feature of our investigation. This was of particular relevance to thematic findings 1 and 3: Climate change as a contemporary and emerging disaster risk, and human development trajectories and their impact and perceptions of a changing world viewed as drivers of current and emerging risk in Oceania. Disaster reporting is typically limited to established classification and human impact outcome. However, the evolution of new and non-traditional health threats can also cause emergency situations. These forces threaten community and public health and well-being, and warrant rethinking about how one classifies disasters in the context of emerging threats to health. Such consideration has implications for the application of the Sendai Framework for Disaster Risk Reduction and activities designed to mitigate disaster impact, and may leverage functions of community resilience and sustainable development. The reported emerging disaster risks in Oceania are not captured by traditional disaster definitions and classification methodology or in existing disaster databases. To improve sensitivity of detection, it is recommended that a review of

disaster classification contextual to emerging threats to health is conducted, and a monitoring program is established to identify and track these drivers of risk.

Current disaster risk management plans should be revised and enhance bottom-up approaches for risk management that develop and enable community action. Action should be initiated to implement education and ownership of risk reduction practice at a person and community level. Such action is reflective of the thematic findings 2 and 5, where engagement, education and partnership with communities in understanding risk, hazard and impact lends itself to shared responsibility. Controls of current and future risks should be developed that are sensitive to human development and the environment, and contextual to the local population.

Thematic finding 4 described in this research provides opportunities to inform, update and improve policy and practice at a regional level. Achieving action in all these areas is a great challenge as it requires long-term political vision and will to enable policy and planning that increase security at an individual, community and national level. Furthermore, if implemented, these practices must be people-centered. The provision of guidance, information, and access to services that incorporate and build on social norms and cultural practices will enhance trust, improve program integration and enable informed decision-making by citizens. Facilitation and leadership at a government level is required to guide this process to achieve activities that are designed to mitigate impact and improve resilience. In short, good governance is a cornerstone for successful implementation of disaster risk reduction strategies.

This study identified key knowledge gaps between measured and perceived disaster risks in Oceania. Recommendations based on comparison of thematic analysis of expert opinion of perceived disaster threats and measured disaster events are reported to inform improved disaster risk reduction practices.

Author Contributions: J.C. developed the conceptual model, examined the CRED EM-DAT database, conducted the interviews and formal analysis of the research under the guidance of the co-authors. Initial writing was conducted by the lead author under guidance and review by the co-authors. J.M.R.-L. contributed to analysis and writing and contributed literature, critically reviewed the paper for intellectual content, read and approved the final version of the paper. F.A. contributed to the study design, formal analysis, writing, review and editing, and supervision. A.R. contributed to formal analysis, writing, review and editing, and supervision.

Funding: This research received no external funding.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A. Interview Questions

Question One:

What do you believe are the top five disaster risks/ threats in the Oceania region today?

What disaster risks do you believe are emerging in the Oceania region over the next decade?

Why do you think these are risks?

What are the drivers of these risks?

Do you have any suggestions on how we can improve disaster risk assessment?

Question Two:

Are the current disaster risk plans and practices suited to the future Disaster risks?

If not, why?

If not, what do you think needs to be done to improve them?

Question Three:

What are the key areas of disaster practice that can enhance future community resilience to disaster risk?

What are the barriers/inhibitors to facilitating this practice?

What are the solutions/facilitators to enhancing community resilience?

References

1. The Sphere Project. *Humanitarian Charter and Minimum Standards in Disaster Response*; Oxfam: Oxford, UK, 2004.
2. Flage, R.; Aven, T. Emerging risk—Conceptual definition and a relation to black swan type of events. *Reliab. Eng. Syst. Saf.* **2015**, *144*, 61–67. [[CrossRef](#)]
3. Burkle, F.M., Jr.; Martone, G.; Greenough, P.G. The changing face of humanitarian crises. *Brown J. World Aff.* **2014**, *20*, 25–42.
4. Krausmann, E.; Cozzani, V.; Salzano, E.; Renni, E. Industrial accidents triggered by natural hazards: An emerging risk issue. *Nat. Hazards Earth Syst. Sci.* **2011**, *11*, 921–929. [[CrossRef](#)]
5. Cuthbertson, J.; Archer, F.; Robertson, A.; Rodruguez-Llanes, J.M. Non-traditional health threats: Redefining the emergency management landscape. *Aust. J. Emerg. Manag.* **2017**, *32*, 40.
6. UNISDR. *Sendai Framework for Disaster Risk Reduction 2015–2030*; 9–11 Rue de Varembe CH 1202; UNISDR: Geneva, Switzerland, 2015.
7. UNISDR; CRED. *The Human Cost of Natural Disasters: A Global Perspective*; UNISDR: Geneva, Switzerland, 2015.
8. Guha-Sapir, D.; Below, R.; Hoyois, P. *EM-DAT: The CRED/OFDA International Disaster Database*; Universite catholique de Louvain (UCL): Brussels, Belgium, 2016.
9. Braun, V.; Clarke, V. Using thematic analysis in psychology. *Qual. Res. Psychol.* **2006**, *3*, 77–101. [[CrossRef](#)]
10. Chand, S.S.; Tory, K.J.; Ye, H.; Walsh, K.J. Projected increase in El Nino-driven tropical cyclone frequency in the Pacific. *Nat. Clim. Chang.* **2017**, *7*, 123. [[CrossRef](#)]
11. Beijing: Integrated Research on Disaster Risk. *Peril Classification and Hazard Glossary (IRDR DATA Publication No. 1)*; Beijing: Integrated Research on Disaster Risk: Beijing, China, 2014.
12. Bearne, A.D.A. *The Future of Historic Districts: A Model For Protecting Our Past From Climate Change*; University of Maryland: College Park, MD, USA, 2016.
13. Bedford, R.; Bedford, C. International migration and climate change: A post-Copenhagen perspective on options for Kiribati and Tuvalu. In *Climate Change and Migration: South Pacific Perspectives*; Institute of Policy: Wellington, New Zealand, 2010; pp. 89–134.
14. Cuthbertson, J.; Archer, F.; Robertson, A. Special Report: WDEM Climate Change Position Statement. *Prehosp. Disaster Med.* **2018**, *33*, 428–431. [[CrossRef](#)]
15. Weir, T.; Virani, Z. Three linked risks for development in the Pacific Islands: Climate change, disasters and conflict. *Clim. Dev.* **2011**, *3*, 193–208. [[CrossRef](#)]
16. Raleigh, C.; Jordan, L.; Salehyan, I. (Eds.) Assessing the Impact of Climate Change on Migration and Conflict. In Proceedings of the Paper Commissioned by the World Bank Group for the Social Dimensions of Climate Change Workshop, Washington, DC, USA, 5–6 March 2008.
17. Patz, J.A.; Campbell-Lendrum, D.; Holloway, T.; Foley, J.A. Impact of regional climate change on human health. *Nature* **2005**, *438*, 310. [[CrossRef](#)]
18. Watts, N.; Adger, W.N.; Ayeb-Karlsson, S.; Bai, Y.; Byass, P.; Campbell-Lendrum, D.; Colbourn, T.; Cox, P.; Davies, M.; Depledge, M.; et al. The Lancet Countdown: Tracking progress on health and climate change. *Lancet* **2017**, *389*, 1151–1164. [[CrossRef](#)]
19. Walker, P. How to think about the future: History, climate change, and conflict. *Prehosp. Disaster Med.* **2009**, *24* (Suppl. 2), 244. [[CrossRef](#)]
20. Intergovernmental Panel on Climate Change. *Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*; Cambridge University Press: Cambridge, UK; New York, NY, USA, 2014.
21. Costello, A.; Abbas, M.; Allen, A.; Ball, S.; Bell, S.; Bellamy, R.; Friel, S.; Groce, N.; Johnson, A.; Kett, M.; et al. Managing the health effects of climate change: lancet and University College London Institute for Global Health Commission. *Lancet* **2009**, *373*, 1693–1733. [[CrossRef](#)]
22. Keim, M.E. Building human resilience: the role of public health preparedness and response as an adaptation to climate change. *Am. J. Prev. Med.* **2008**, *35*, 508–516. [[CrossRef](#)] [[PubMed](#)]
23. WDEM. Climate Change Position Statement. *Prehosp. Disaster Med.* **2017**, *32*, 351. [[CrossRef](#)] [[PubMed](#)]
24. Gursky, E.A.; Burkle, F.M.; Hamon, D.W., Jr.; Walker, P.; Benjamin, G.C. The changing face of crises and aid in the Asia-Pacific. *Biosecur. Bioterror. Biodef. Strategy Pract. Sci.* **2014**, *12*, 310–317. [[CrossRef](#)] [[PubMed](#)]

25. Whitmee, S.; Haines, A.; Beyrer, C.; Boltz, F.; Capon, A.G.; de Souza Dias, B.F.; Ezeh, A.; Frumkin, H.; Gong, P.; Head, P.; et al. Safeguarding human health in the Anthropocene epoch: Report of The Rockefeller Foundation–Lancet Commission on Planetary Health. *Lancet* **2015**, *386*, 1973–2028. [[CrossRef](#)]
26. The Lancet Planetary Health. Can Europe lead the transformation of the plastic pollution crisis? *Lancet Planet. Health* **2018**, *2*, e274. [[CrossRef](#)]
27. Eriksen, M.; Lebreton, L.C.; Carson, H.S.; Thiel, M.; Moore, C.J.; Borerro, J.C.; Galgani, F.; Ryan, P.G.; Reisser, J. Plastic pollution in the world's oceans: More than 5 trillion plastic pieces weighing over 250,000 tons afloat at sea. *PLoS ONE* **2014**, *9*, e111913. [[CrossRef](#)] [[PubMed](#)]
28. Murray, C.J.L.; King, G.; Lopez, A.D.; Tomijima, N.; Krug, E.G. Armed conflict as a public health problem. *BMJ Br. Med. J.* **2002**, *324*, 346–349. [[CrossRef](#)]
29. Barnett, J.; Adger, W.N. Climate change, human security and violent conflict. *Polit. Geogr.* **2007**, *26*, 639–655. [[CrossRef](#)]
30. Jacobs, L.M.; Burns, K.J.; Gross, R.I.; Jacobs, L.M.; Burns, K.J.; Gross, R.I. Terrorism: A public health threat with a trauma system response. *J. Trauma* **2003**, *55*, 1014–1021. [[CrossRef](#)] [[PubMed](#)]
31. World Economic Forum. *The Global Risks Report 2015*; World Economic Forum: Cologny, Switzerland, 2015.
32. World Economic Forum. *The Global Risks Report 2017*; World Economic Forum: Cologny, Switzerland, 2017.
33. World Health Organization. *Risk Reduction and Emergency Preparedness WHO Six Year Strategy for the Health Sector and Community Capacity Development*; World Health Organization: Geneva, Switzerland, 2006.



© 2019 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<http://creativecommons.org/licenses/by/4.0/>).

5.7.2.3 Discussion

This study characterized perceptions of the nature and type of contemporary and emerging disaster risk with potential impacts in Oceania with five specific themes.

1. Climate change is viewed as a contemporary and emerging disaster risk in Oceania
2. The geography and location of Oceania is a factor related to its natural risk profile. Risk is contextual to place and person
3. Human development and impact are viewed as drivers of current and emerging risk in Oceania. Perceptions of a changing world are considered to be related to perceived risks
4. Current disaster risk plans and practices are not suited to the future Disaster risks. There is a perceived disconnect between the end user (community) and the developer (government). Lack of political will and poor governance are viewed as barriers to improvement.
5. Increased education of risk and risk assessment at a local level is recommended to develop downstream activities with upstream commitment and enhance community connection with risk ownership, leadership and action. Improvement requires a people centric approach that is supported at all levels.

The Oceania region is one of the most disaster-prone regions in the world. Populations in Oceania suffer high exposure of natural hazards. This is exacerbated by climate change causing increasing frequency and intensity of weather-related hazards. The Commonwealth Scientific and Industrial Research Organisation (CSIRO) State of the Climate report shows that Australia's average temperature had increased by 1 degree since 1910, with a resultant increase in intensity and duration of heatwaves and bushfires[86]. The United Nations Framework Convention on Climate Change (UNFCCC) define climate change as that which 'directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods'[87]. The IPCC definition of climate change is 'changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer'[88].

The effects of climate change increase the frequency and intensity of weather, consequently increasing related hazards such as floods, cyclones, heatwaves and fires. Long term effects of climate change of drought may increase fresh water scarcity and food production that further decrease community resilience[89]. Such impacts will adversely affect the health status of populations, increase vulnerability and challenge, limit or damage developmental programs particularly in areas of greatest need[90].

Respondents to this research felt that current disaster risk plans and practices were not suited to the future disaster risks and that there was disconnect between the end user (community) and the developer (government). The impact of disaster varies between persons due to pre-existing variation in their social vulnerability. Wisner et al described social vulnerability as people's 'capacity to anticipate, cope with, resist and recover from the

impacts of a natural hazard'[91]. Ergo, the impact of disaster is reflective of societal capacity and choices made on resource allocation pre-event.

The study findings captured not only traditional and contemporary risks, such as climate change, but also less obvious ones, such as plastic pollution, rising inequality, uncontrolled urbanization, and food and water insecurity, which were perceived as contributors to current and/or future crises, or as crises themselves. The findings provided insights into how to improve disaster management more effectively, mainly through bottom-up approaches and education to increase risk-ownership and community action, enhanced political will, good governance practices and support of a people-centric approach. The challenge required to achieve action in all these areas are great as it requires long term political vision and will to enable policy and planning that increases security at an individual, community and national level. Furthermore, if implemented these practices must be people centred. The provision of guidance, information, and access to services that incorporate and build on social norms and cultural practices will improve program integration and enable informed decision making by citizens.

Further research conducted post publication has identified additional findings of Pacific health security and Community planning and governance as key factors for improving disaster risk management in Oceania. The next chapter explores this with further, additional data collected and analysed.

5.8 STUDY 1 EXTENSION: PERCEPTIONS OF DISASTER RISK IN THE PACIFIC

5.8.1 Introduction

This study aimed to investigate perceptions of disaster risk in the Pacific.

5.8.2 Rationale and methodology

This study was informed by and expanded our earlier study which peer review feedback noted a focus largely on Australian perspectives[92]. This additional small study was undertaken following the peer reviewed published paper.

The study used the same questionnaire tool to profile current and future disaster risks in the Pacific.

A targeted literature review and international disaster database analysis underpinned the study. The Sendai Framework provided the conceptual framework to guide the design and analysis of the study. Interview questions were developed to explore perceptions of current and emerging disaster risk not currently captured by existing disaster event databases. This purpose is reflective of the intent of the Sendai Framework in identifying underlying disaster risk drivers and addressing the systemic drivers of risk in relation to climate change, health, sustainable development and resilience building [26].

Key informant interviews with 3 practitioners, policy managers or academics in disaster management in the Pacific provided first-hand insights into their perceptions of current and emerging disaster risk and identified opportunities to enhance disaster risk management practice. The 3 practitioners complemented the findings of the 7 interviewees from the Pacific in the original Oceania study and showed consistency in findings with their peers in this extension study and of those in the original Ocean study.

Qualitative methods were used to analyse these key informant interviews. Ethics approval was gained through Monash University.

5.8.3 Results

Participant Gender:
<ul style="list-style-type: none"> • Male: • Female: 3
Participant Location:
New Zealand (2), Vanuatu (1).

Question One:
<ul style="list-style-type: none"> • 3 answers associated with volcano and earthquake • 6 answers associated with funding, fuel, food and water insecurity during a disaster • 5 answers associated with disease
Question Two:
<ul style="list-style-type: none"> • 4 answers associated with community engagement is risk management
Question Three:
<ul style="list-style-type: none"> • 5 answers associated with funding • 3 answers associated with governance

Phase Two

Box 2: Coded transcript	
Transcript	Codes
<ul style="list-style-type: none"> • <i>Cyclone, volcano, earthquake, loss of water and food due to the event, isolation with communication cut off, no funds, no cash.</i> • <i>Natural/geographic isolation is compounded by event that cuts communication and funding sources.</i> • <i>Outbreak of disease, health care and hygiene, limited vaccination program challenges, tourism</i> 	Earthquake and volcano were identified as current disaster risks in the Pacific. Island states have limited independent capability or resource access when impacted by disaster.

<p><i>brings in disease, flu outbreak is hard to manage</i></p> <ul style="list-style-type: none"> • <i>Reliance on ability to access fuel from Australia and Fiji to produce power.</i> • <i>Dependencies related to geographic isolation are a disaster risk.</i> • <i>Disaster risk reduction activities at community level are funding dependent.</i> • <i>Flooding, heat, climate change, earthquakes, volcano</i> • <i>Hydrometeorological (more than geophysical) – high impact weather, tsunami, drought, earthquake (subduction zones in Vanuatu, Tonga and NZ), volcano.</i> 	
<ul style="list-style-type: none"> • <i>Immunity to antibiotics, overuse and risk of antimicrobial resistance. Non communicable diseases are increasing, diabetes and sexual transmitted disease rates are soaring. During times of disaster processed foods (white rice, white sugar, white bread) are distributed.</i> • <i>Sexually transmitted diseases (STDs).</i> • <i>Clean water, food security, changing severity of events, re-emergence of old diseases.</i> • <i>No new ones compared to list but add wildfires and landslide (but less severe). Expect an increase in high weather events and drought.</i> 	<p>Infectious disease, food and water security, and weather-related events are perceived to be emerging threats</p>
<ul style="list-style-type: none"> • <i>More prevalence noted of non-communicable disease-causing increased mortality and morbidity rates. Increased access to anti biotics results in community acceptance and expectation.</i> • <i>Acceptance of low age death rates.</i> • <i>Young generation behaviour and presentation of multiple STDs in individuals.</i> • <i>Not adapting fast enough (changing severity). In Oceania history is short and quickly forgotten. Not enough merit is given to indigenous folklore and lessons.</i> • <i>Because they'll be exacerbated by climate change.</i> 	<p>Increased prevalence of disease in the population, and increased access and usage of antibiotics were viewed as causes of current and emerging risk</p>

<ul style="list-style-type: none"> • <i>Access and promotion of unhealthy nutrition creates acceptance and expectation of dietary intake, perceptions of unhealthy diet access = social status. White rice access is related to social status in island communities due to low access and availability, yet it causes poor health outcomes.</i> • <i>Food security, biosecurity challenges, overfishing of Oceania reducing food supply causing increased cost and also causing plastic pollution (nets).</i> • <i>Selling off of water rights driving up increased use of bottled water, increased water cost and pollution (plastic). Atolls have limited supply; volcano eruption can interrupt supply.</i> • <i>Climate change (also in GAR19).</i> 	<p>Climate change and impacts of globalisation upon society and impacting food and water security were perceived as drivers of risk</p>
<ul style="list-style-type: none"> • <i>Provision of disaster relief practices in respect to nutrition and provision of food supply.</i> • <i>Use indigenous knowledge in DRR, this is not commonly included in modern DRR plans or knowledge.</i> • <i>More open acknowledgement of new ideas, understand increased global connectivity and impacts.</i> • <i>Standardised approach across Oceania in DRR. Enable a regional scale assessment of problems and develop improved (standardised) disaster loss databases (recommended by UNDP).</i> • <i>They need to add to them, be more open to asking for help to support local leadership and response when demand exceeds capacity. Large volcano events present significant overwhelming risk with catastrophic impact (local/transport).</i> • <i>20 years behind because we don't follow plans (except some specific ones such as quarantine) due to political influence and money. Barriers related to the cost of doing something, the cost of preparing, lack of willingness to change</i> 	<p>Current disaster plans were not thought to be future ready. Improved and standardised measurement of disaster impact, and greater recognition and use of community driven programs for DRR were suggestions for improving DRR</p>

<ul style="list-style-type: none"> • <i>Lack of accurate risk assessments that are up to date to enable better planning. Reduce siloing between knowledge centres/ data holders/ operations. We need contextual plans for Oceania islands.</i> • <i>Need plans based on consequences not just hazards in settings where causes are unknown.</i> 	
<ul style="list-style-type: none"> • <i>EMT development and enhancement across Vanuatu, not just port villa</i> • <i>Increased voice of communities to identify needs and understand risk. Use adaptation instead of resilience. Look backwards at traditional learning and forwards at future risk and accept change to build back better.</i> • <i>Don't allow building in risk areas (profit barrier).</i> • <i>At the highest-level commitment to Sendai and working together on drivers such as climate change and sustainable development with urgency.</i> • <i>Early warning systems are key (particularly tsunami/earthquake in Oceania)</i> • <i>Villa vs Santo is a barrier (political context). Finances/funding to support development.</i> • <i>Profit margins, lack of government will, industrialisation causing climate change, governance by passport is reducing migration ability equals reduction/restriction in adaptation.</i> • <i>Technology, there are also risks to early warning systems due to dependency, possible failure and over reliance.</i> • <i>Spreading/decentralising EMT workforce from Port Villa or additional hub (Villa was cut off in cyclone Pam).</i> • <i>Balance community engagement with risk knowledge when building back better to make wise decisions. Less socio-economic divide and political/ state community divide in Oceania.</i> 	<p>Community engagement, collaboration between island states, and high-level commitment was recommended as methods to improving DRR planning. Political will and funding access were identified as barriers and community leadership, poverty reduction and application of early warning systems was suggested solutions/facilitators for enhancing community resilience</p>

<ul style="list-style-type: none"> • <i>Introduce early warning systems with social science to understand social context.</i> • <i>Strong communities that are strong normally are resilient to disasters</i> • <i>Lift people out of poverty to improve future disaster resilience (developing countries).</i> 	
--	--

Phase Three

The following generated codes were assessed for theme generation:

1. Earthquake and volcano were identified as current disaster risks in the Pacific. Island states have limited independent capability or resource access when impacted by disaster.
2. Infectious disease, food and water security, and weather-related events are perceived to be emerging threats
3. Increased prevalence of disease in the population, and increased access and usage of antibiotics were viewed as causes of current and emerging risk
4. Climate change and impacts of globalisation upon society and impacting food and water security were perceived as drivers of risk
5. Current disaster plans were not thought to be future ready. Improved and standardised measurement of disaster impact, and greater recognition and use of community driven programs for DRR were suggestions for improving DRR.
6. Community engagement, collaboration between island states, and high-level commitment was recommended as methods to improving DRR planning. Political will and funding access were identified as barriers and community leadership, poverty reduction and application of early warning systems was suggested solutions/facilitators for enhancing community resilience

Using the Braun and Clark methodology where a theme “captures something important about the data in relation to the research question, and represents some level of patterned response or meaning within the data set” [71], the codes were reviewed to identify similarity or overlap and whether unification of codes into central themes or sub themes was appropriate. Exploration of risk within interviewee responses demonstrated three main risks relative to the Oceania region: disease, food and water security and resilience related to geographical isolation. These three themes were collapsed into a theme of Pacific health security. Community engagement, political governance and funding were identified as consistently reported barriers and/or solutions to improvement. A theme of community planning and governance was derived from these findings. The final two themes developed were:

- 5 Pacific health security
- 6 Community planning and governance.

The two developed themes with illustrated quotes are shown in Phase 4 table 1.

Phase Four

Table 14: Five themes developed from seven codes with illustrative data extracts (direct quotes)

Pacific health security	Community planning and governance
<p><i>Cyclone, volcano, earthquake, loss of water and food due to the event, isolation with communication cut off, no funds, no cash.</i></p> <p><i>Natural/geographic isolation is compounded by event that cuts communication and funding sources.</i></p> <p><i>Outbreak of disease, health care and hygiene, limited vaccination program challenges, tourism brings in disease, flu outbreak is hard to manage</i></p> <p><i>Reliance on ability to access fuel from Australia and Fiji to produce power.</i></p> <p><i>Dependencies related to geographic isolation are a disaster risk.</i></p> <p><i>Disaster risk reduction activities at community level are funding dependent.</i></p> <p><i>Flooding, heat, climate change, earthquakes, volcano</i></p> <p><i>Hydrometeorological (more than geophysical) – high impact weather, tsunami, drought, earthquake (subduction zones in Vanuatu, Tonga and NZ), volcano</i></p> <p><i>More prevalence noted of non-communicable disease-causing increased mortality and morbidity rates. Increased access to anti biotics results in community acceptance and expectation.</i></p> <p><i>Acceptance of low age death rates.</i></p>	<p><i>Provision of disaster relief practices in respect to nutrition and provision of food supply.</i></p> <p><i>Use indigenous knowledge in DRR, this is not commonly included in modern DRR plans or knowledge.</i></p> <p><i>More open acknowledgement of new ideas, understand increased global connectivity and impacts.</i></p> <p><i>Standardised approach across Oceania in DRR. Enable a regional scale assessment of problems and develop improved (standardised) disaster loss databases (recommended by UNDP).</i></p> <p><i>Lack of accurate risk assessments that are up to date to enable better planning. Reduce siloing between knowledge centres/ data holders/ operations. We need contextual plans for Oceania islands.</i></p> <p><i>Need plans based on consequences not just hazards in settings where causes are unknown.</i></p> <p><i>EMT development and enhancement across Vanuatu, not just port villa</i></p> <p><i>Increased voice of communities to identify needs and understand risk. Use adaptation instead of resilience. Look backwards at traditional learning and forwards at future risk and accept change to build back better.</i></p> <p><i>Don't allow building in risk areas (profit barrier).</i></p> <p><i>At the highest-level commitment to Sendai and working together on drivers such as climate change and sustainable development with urgency.</i></p>

<p><i>Young generation behaviour and presentation of multiple STDs in individuals.</i></p> <p><i>Not adapting fast enough (changing severity). In Oceania history is short and quickly forgotten. Not enough merit is given to indigenous folklore and lessons.</i></p> <p><i>Immunity to antibiotics, overuse and risk of antimicrobial resistance. Non communicable diseases are increasing, diabetes and sexual transmitted disease rates are soaring. During times of disaster processed foods (white rice, white sugar, white bread) are distributed.</i></p> <p><i>Sexually transmitted diseases (STDs).</i></p> <p><i>Clean water, food security, changing severity of events, re-emergence of old diseases.</i></p> <p><i>No new ones compared to list but add wildfires and landslide (but less severe). Expect an increase in high weather events and drought.</i></p>	<p><i>Early warning systems are key (particularly tsunami/earthquake in Oceania)</i></p> <p><i>Villa vs Santo is a barrier (political context). Finances/funding to support development.</i></p> <p><i>Profit margins, lack of government will, industrialisation causing climate change, governance by passport is reducing migration ability equals reduction/restriction in adaptation.</i></p> <p><i>Technology, there are also risks to early warning systems due to dependency, possible failure and over reliance.</i></p> <p><i>Spreading/decentralising EMT workforce from Port Villa or additional hub (Villa was cut off in cyclone Pam).</i></p> <p><i>Balance community engagement with risk knowledge when building back better to make wise decisions. Less socio-economic divide and political/ state community divide in Oceania.</i></p> <p><i>Introduce early warning systems with social science to understand social context.</i></p> <p><i>Strong communities that are strong normally are resilient to disasters</i></p> <p><i>Lift people out of poverty to improve future disaster resilience (developing countries).</i></p>
--	--

5.8.4 Discussion

Pacific health security.

Pacific Island States are classified as Small Island Developing States. This region is recognised for its high frequency of natural hazards coupled with limited capacity to mitigate impact resulting in heightened vulnerability.

Economic impact assessment resulting from disaster effects have estimated greater than 10% damage to the regions GDP as a consequence of disasters affecting over 11% of the population [93].

Health security for populations residing in the Pacific was a robust feature of the extended analysis. In particular the intersection of health impacts on indigenous communities related to development, their resultant health status and the relationship of these to disaster risk provided a unique appreciation of how health determinants contribute to population vulnerability during and post disaster impact.

The Asian Development Bank has investigated impacts to human health in the Asia Pacific region related to climate change. Consistent with the findings in this research risks of decreased nutrition and access to clean water, increasing disease rising sea levels and increased frequency of natural disasters were reported[94]

Climate change will influence Pacific population Social Determinants of Health as the impact of climate change will directly contribute to community physical condition, social status, poverty, control over resources and access to food and water[95, 96]

Community planning and governance.

Desire for increased community engagement in disaster planning and improved governance of disaster risk reduction activities are not new research findings. Identifying this theme within the findings of the extended analysis is complementary to the findings of the initial research and underpins similar themes derived. Unique features of small island states facing similar disaster risks provides opportunity to improve cooperation and sharing of resources to enhance capability. In *Disaster Governance in the Southwest Pacific* Cook and Chen recommended such inter-regional cooperation in disaster management and climate security to improve disaster governance[97]. Key recommendations in enabling such an approach included partnership with ASEAN in development of an inter-regional disaster governance agreement, joint disaster management training and shared capacity building [97].

This additional data collection and analysis further informed study 1. Pacific health security and community planning and governance were identified as central to disaster risk reduction activities by local community members. Of note was that the respondents worked primarily in the health sector. The Lancet countdown focus is through a health lens, and in doing so recognises the health profession as essential in driving forward progress on climate change and realising the health benefits of this response. The Lancet Countdown tracks

progress on health and climate change and provides an impact assessment. Its findings thus far have reported:

- That the human symptoms of climate change are unequivocal and potentially irreversible affecting the health of populations around the world today, and.
- That the delayed response to climate change over the past 25 years has jeopardised human life and livelihoods[98, 99]

Such action is complementary to the purpose and intent of the Sendai Framework for Disaster Risk Reduction which recommends actions to enhance resilience of national health systems; enable and strengthen policies and social programs which improve equity and access health care and reduce poverty; and empower and assist vulnerable persons who are disproportionately affected by disasters[26, 100]. Achieving healthcare leadership in the Oceania region would be supportive of improving equity, social justice and reduction of conditions that cause harm as Health care professionals care for people, communities, societies and are well places to guide transition in practice from managing disasters to managing the risks which drive them.

This chapter and included study and the preceding two papers have gathered and analysed data to characterise current and emerging disaster risk in Oceania. The next chapter provides specific focus on climate change as a driver of disaster risk in Oceania, highlighted within the preceding chapters as a key threat.

5.9 CLIMATE CHANGE RISK

5.9.1 Introduction

Climate change was reported as one of the most significant drivers of disaster risk in Oceania by respondents interviewed in this PhD. The United Nations Framework Convention on Climate Change (UNFCCC) define climate change as that which ‘directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods’[87]. The Intergovernmental Panel on Climate Change (IPCC) definition of climate change is ‘changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer’[88]. The effects of climate change increase the frequency and intensity of weather, consequently increasing related hazards such as floods, cyclones, heatwaves and fires. Long term effects of climate change of drought may increase fresh water scarcity and food production that further decrease community resilience[89]. Such impacts will adversely affect the health status of populations, increase vulnerability and challenge, limit or damage developmental programs particularly in areas of greatest need[90].

The World Health Organization (WHO) Operational framework for building climate resilient health systems categorises health risks from climate change as:

- Direct impacts arising from the heightened frequency and severity of extreme weather events.
- Environmentally mediated impacts, including air pollution, decreasing fresh water and changing patterns of disease; and
- Socially mediated impacts, including undernutrition, mental illness, population displacement and poverty, occurring from adverse pressure on human systems[101].

5.9.2 Published Position Statement World Association of Disaster and Emergency Medicine Climate Change.

Climate change is affecting disaster risk and disaster impact and is recurrently cited as the most important perceived challenge of this century [98, 102]. Yet, the perceptions of the risk of climate change, its societal impacts, ramifications and particularly the solutions needed to address it require dedicated, comprehensive action. The World Association of Disaster and Emergency Medicine (WADEM) mission is the evidence-based improvement, education, and advocacy of emergency and disaster health care and disaster risk reduction. WADEM recognizes climate change as a world-wide environmental health problem, and its responsibility to support the capacity of emergency management, humanitarian and health professionals to address the disaster impacts of climate change[103]. In 2017 The WADEM Oceania chapter led and developed WADEM's first organisational position statement focussed on climate change. I was fortunate to have been the Chairperson of the Oceania chapter at this time and coordinated development, drafted and published the position statement in Prehospital and Disaster Medicine[103]. The development of this statement received input from international health and disaster management leads to inform and describe WADEM and its international members view and stance on reducing disaster risk related to climate change.



Position Statement: Climate Change

Climate change is affecting disaster risk and disaster impact. WADEM recognizes climate change as an issue of global concern. It is WADEM's responsibility to support the capacity of emergency management, humanitarian, and health professionals to address the disaster impacts of climate change.

WADEM supports health improvement activities, with emphasis on health promotion during and following a disaster with emphasis on reducing the effects of climate change, achieved by cooperation among and between multidisciplinary professions involved in research, education, management, and practice in prehospital, emergency, public health, and disaster health care.

The United Nations General Assembly has encouraged the Intergovernmental Panel on Climate Change to continue to assess the adverse effects of climate change upon communities and recognises the need for implementation of disaster risk reduction programmes¹. The Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation² and the Fifth Assessment Report produced by the Intergovernmental Panel on Climate Change³ provide an updated review of scientific knowledge relevant to climate change and reported consensus on emerging risks associated with climate change; as such it represents an emerging threat to the health status of communities. Impact categories identified by these reports relative to disaster risk include:

- Increased morbidity and mortality due to extreme heat waves, fire, and other extreme weather events;
- Biodiversity changes leading to infectious disease spread and duration due to alterations in weather and vector distribution;
- Reduced food yields due to drought;
- Increased displacement of populations; and
- Increased risk of conflict, poverty, and economic shock.

The Lancet Countdown on tracking progress on health and climate change is an international,

¹ United Nations General Assembly Resolutions on Natural Disasters and Vulnerability (59/233 and 58/215).

² IPCC. Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. Intergovernmental Panel on Climate Change [Core Writing Team: Field CB, Barros V, Stocker TF, et al]. IPCC; Geneva, Switzerland; 2012:582pp.

³ IPCC. Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II, and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team: Pachauri RK and Meyer LA (eds.)]. IPCC; Geneva, Switzerland; 2014:151pp.

multidisciplinary research collaboration which aims to track the health impacts of climate hazards, health resilience and adaptation, health co-benefits of climate change, and calls for mitigation and broader political engagement.⁴

The Sendai Framework for Disaster Risk Reduction (2015-2030), a 2015 UN landmark agreement, outlines priorities for action while identifying climate change as both a driver of disaster risk and as an influencing factor of disaster impact and sustainable development.⁵

As a result, WADEM:

- Recognizes the importance of climate change due to its influence on frequency and severity of natural hazards, and on disasters of natural, public health-related, and conflict causes; and
- Recommends all disaster and emergency professionals and organisations adopt a risk-based approach to emergency planning that prepares for and enhances resilience to climate change effects and recommends linking this to the implementation of the *Sendai Framework for Disaster Risk Reduction* (2015-2030).

⁴ Watts N, et al. The Lancet Countdown: Tracking Progress on Health and Climate Change. *Lancet*. 2017;389(10074):1151–1164.

⁵ United Nations General Assembly. *Sendai Framework for Disaster Risk Reduction 2015-2030*. A/RES/69/283: 2015.

5.9.3 Peer reviewed published paper: Special Report: WADEM Climate Change Position Statement

The WHO Western Pacific Region has recognised the amplification effect of climate change on existing health burdens and has prioritised action to mitigate impacts it poses to Pacific communities[104]. The National Climate Resilience and Adaptation Strategy describes Australian government risk management approaches to climate change and initiatives to build capacity for adaptation and resilience[105].

The following report was produced to provide an overview on action taken to develop a position paper for the World Association of Disaster and Emergency Medicine with a specific focus on climate change and disasters, and a focussed perspective of the specific risks of climate change in Oceania.

Special Report: WADEM Climate Change Position Statement

Joseph Cuthbertson;¹ Frank Archer;¹ Andy Robertson²

1. Monash University, Melbourne, Victoria, Australia
2. Western Australia Department of Health, Perth, Western Australia

Correspondence:

Joseph Cuthbertson
Monash University
Monash University Disaster Resilience Initiative
Clayton, Melbourne, Victoria 3800 Australia
E-mail: Joseph.Cuthbertson@monash.edu

Conflicts of interest: none

Keywords: climate change; disaster risk reduction; health

Abbreviations:

WADEM: World Association for Disaster and Emergency Medicine
WHO: World Health Organization

Received: December 21, 2017

Revised: February 23, 2018

Accepted: March 4, 2018

Online publication: July 17, 2018

doi:10.1017/S1049023X18000535

Abstract

The World Association for Disaster and Emergency Medicine (WADEM; Madison, Wisconsin USA) is a multi-disciplinary professional association whose mission is the global improvement of prehospital and emergency health care, public health, and disaster health and preparedness. In April 2017, the biennial general meeting of the World Congress for Disaster and Emergency Medicine (WCDEM) endorsed the WADEM Climate Change Position Statement, which was subsequently published in *Prehospital and Disaster Medicine* in July 2017. This special report examines literature used and reviews the process of development of this Position Statement as a product of WADEM.

Cuthbertson J, Archer F, Robertson A. Special report: WADEM climate change position statement. *Prehosp Disaster Med.* 2018;33(4):428–431.

Introduction

The World Association for Disaster and Emergency Medicine (WADEM; Madison, Wisconsin USA) is a multi-disciplinary professional association whose mission is the global improvement of prehospital and emergency health care, public health, and disaster health and preparedness.¹ Currently, WADEM recognizes its responsibility as a multi-disciplinary leader in health to provide guidance and engage in climate science. The development of the WADEM Climate Change Position Statement was undertaken by the WADEM Board of Directors in conjunction with the WADEM Oceania Chapter, who are cognizant of the threat that climate change poses to population health and livelihood in the Asia-Pacific region.

The WADEM Oceania Chapter and Board of Directors reviewed policy statements and key literature related to climate change and disasters. Then, WADEM drafted and released this Position Statement to illuminate the global disaster risk to health presented by climate change. The target audience for this Position Statement included WADEM members, readers of *Prehospital and Disaster Medicine*, and the global disaster health community. The Position Statement will be updated as climate science evolves and as carefully structured impact evaluations of related disaster health interventions come to hand.

In the Position Statement, WADEM:

- recognizes the importance of climate change due to its influence on frequency and severity of natural hazards, and on disasters of natural, public health related, and conflict causes; and
- recommends all disaster and emergency professionals and organizations adopt a risk-based approach to emergency planning that prepares for and enhances resilience to climate change effects and recommends linking this to the implementation of the Sendai Framework for Disaster Risk Reduction (2015–2030).²

The significant elements of literature identifying the contemporary association between climate change and disaster, and the implications for sustainable development and health used in the Position Statement, are summarized in this special report.

Disaster Risk Reduction

Disaster risk reduction is a holistic approach to long-term community and state development that unifies preparation and mitigation practices. Its function has been described as “lying between the interface of humanitarian response to disasters and developmental programs.”³ It is more than this, however, as the context of disaster risk reduction is broader

than that of the developing country model and speaks equally to the long-term planning needs of developed countries.

The effects of climate change are an emerging risk to health and have bearing upon sustainable development, disaster risk reduction, and health agendas. Climate change and its relationship to disaster is clearly articulated in the Sendai Framework and follows the identification and description of climate change impact on disaster in the Hyogo Framework for Action (2005–2015).^{4,5} The Sendai Framework identifies the importance of climate change and disaster risk reduction; in particular, the Sendai Framework calls for “addressing climate change as one of the drivers of disaster risk” and that “more dedicated action needs to be focused on tackling underlying disaster risk drivers, such as the consequences of poverty and inequality, climate change, and variability.”⁴ The focus of the Sendai Framework for action in respect to climate change is specifically related to disaster risk assessment. This is noteworthy in that it articulates the relationship between climate change and disaster risk and sets the tone of policy relationship between the Sendai Framework and the United Nations (New York USA) Framework Convention on Climate Change Paris Agreement. This clarity assists in defining the scope of the Sendai Framework and identifying the need for collaboration in disaster risk assessment and management across policies and sectors. The WADDEM Climate Change Position Statement clearly reflects the need to adopt a risk-based approach to emergency planning that prepares for and enhances resilience to climate change effects.

Climate Change and Health

The Fifth Assessment Report produced by the Intergovernmental Panel on Climate Change (Geneva, Switzerland) provided a consensus of scientific knowledge relevant to climate change.⁶ Four impact categories identified by the report associated with contemporary disasters include: reduced food yields due to drought; increased morbidity and mortality due to extreme heat waves; fire and extreme weather events; and changes in infectious disease geographical spread and seasonal variation due to alterations in weather and vector distribution. Climate change was described by the Lancet Commission (London, UK) in 2009 as “the biggest global health threat of the 21st century.”⁷ Six years later in 2015, Watts, et al published the Lancet Commission on Health and Climate Change and initiated five thematic workgroups to develop and monitor health impact due to climate change.⁸ These thematic areas included: climate hazards; health resilience and adaptation; health co-benefits of climate change mitigation; economics and finance; and political and broader engagement, and found that the impact of global warming on human health was a health emergency.⁸

Findings from the 2017 Lancet Countdown on Health and Climate Change (London, UK) noted a 46% increase in the frequency of weather-related disasters since the year 2000. Indicator 1.4 of the Lancet Countdown, *Lethality of Weather-Related Disasters*, found no clear trend in lethality of weather-related disasters in this time period; however, 90% of disasters in the last 20 years have been associated with weather-related events.⁹ Importantly, the burden of deaths associated with disasters caused by natural hazards predominantly affects poorer countries.¹⁰

More broadly, the emergence of discussion regarding planetary health has engaged the health sector to focus on the related impact upon humanity. The alignment of public and planetary health as a construct of health determinants was proposed by Horton, et al¹¹

and the ability and responsibility of health professionals as public health advocates in ensuring action on climate change is proposed in the Lancet Countdown⁹ and endorsed in the WADDEM Position Statement.

The World Health Organization’s (WHO; Geneva, Switzerland) Risk Reduction and Emergency Preparedness Strategy for the health sector and community capacity development reflects the recommendations of a global consultation organized by the Health Action in Crisis Cluster.¹² Since 2005, the WHO, within its role as health cluster lead, has implemented planning processes to strengthen emergency preparedness and response activities with a specific targeting of action at a community level. As a consequence, this strategic framework signals a shift from traditional, short-term focused emergency management doctrine to one of capacity building, developing resilience, and reducing vulnerability. The challenge in achieving this goal, as described by the strategic framework, is:

Establishing systematic capacities, such as legislation, plans, coordination mechanisms and procedures, institutional mechanisms and budgets, skilled personnel, information and public awareness, and participation that can measurably reduce future risks and losses.¹²

This strategy also recognizes the importance of applying a “whole of health” approach and utilizes the WHO definition of health as the benchmark for intervention effectiveness. This strategic direction complements efforts in other areas, notably the agenda for Sustainable Development and the Sendai Framework for action.

Humanitarian Emergencies

Many small island states in Oceania are vulnerable to the effects of climate change. Sea level rise at almost three-times the global average has been reported in the Solomon Islands, five reef islands are reported as lost to rising sea levels and erosion, and Nuatambu Island has lost more than one-half of its habitable area.¹³ Rising sea levels, increasing frequency and intensity of tropical storms, and acidification of ocean water are expected to make parts of Kiribati uninhabitable. The people of Kiribati are expected to begin climate migration in 2020.¹⁴

The *Protecting the Health of Vulnerable People from the Humanitarian Consequences of Climate Change and Climate-Related Disasters* paper was submitted to the Inter-Agency Standing Committee Task Force on Climate Change (Geneva, Switzerland) by the WHO in 2009. Five policy directions designed to protect and enhance human health and well-being from the risks of climate change were proposed, which included strengthening of public health systems, enhancing capacity to address public health emergencies, strengthening surveillance and control of infectious disease, improving the use of early warning systems by the health sector, and enhancing local public health interventions to enhance community resilience to climate change and climate-related disasters.¹⁵

The current drought affecting millions of people across Kenya, Yemen, South Sudan, and Somalia has demonstrated the need for further action on this guidance as this event is evolving as one of the greatest preventable humanitarian emergencies of the generation. In a statement to The UN Security Council (New York USA) on March 10, 2017, Mr. Stephen O’Brien, Under-Secretary-General for Humanitarian Affairs and Emergency Relief Coordinator, reported this event as the worst crisis since the

2nd World War and the largest humanitarian crisis since the creation of the United Nations.¹⁶ Thus, WADEM has highlighted its responsibility to support the capacity of emergency management, humanitarian, and health professionals to address the disaster impacts of climate change.²

Global Urbanization

The Habitat III Issue Paper 17, co-led by United Nations Development Programme (UNDP; New York USA) and UN-Habitat (Nairobi, Kenya), investigated climate change and disasters in urban areas. Urban population size is now estimated to have exceeded rural populations, and by the year 2050, the proportion of populations living in urban areas is estimated to be 66%.¹⁷ The consequences of increased urbanization, climate change, and related disasters are not well understood; additionally, vulnerability to climate change is greater in some urban areas and populations than others. Informal settlements established on land vulnerable to natural disasters, with absence or limited application of planning or building codes, can increase hazards to urban populations. Invariably, these populations are also suffering the consequences of poverty and inequality and are less resilient to climate change impact and disasters.⁶

Sustainable Development

Sustainable development has been defined as: “development that meets the needs of the present without compromising the ability of future generations to meet their own needs.”¹⁸ The Johannesburg Plan of Implementation of the World Summit on Sustainable Development found that:

An integrated, multi-hazard, inclusive approach to address vulnerability, risk assessment, and disaster management, including prevention, mitigation, preparedness, response, and recovery, is an essential element of a safer world in the 21st century.¹⁹

In the Seventieth Session of the United Nations on September 25, 2015, the General Assembly adopted 2030 Agenda for Sustainable Development to end poverty and hunger, protect the planet, and ensure prosperity for all.²⁰ The 17 goals that comprise the sustainable development goals are intimately linked with disaster risk reduction targets and climate change adaptation. As the global lead for the development, the United Nations Development Programme has focused three out of seven outcome areas of their strategic plan on disaster risk reduction, energy, and climate change.²¹ In alignment with this, the Sendai Framework has endorsed coherence of disaster risk reduction and sustainable

development policies, programs, and actions as a guiding principle and stated that effective disaster risk reduction contributes to progress on achieving the Sustainable Development Goals.⁴ In short, disaster risk reduction is essential to achieve sustainable development.

Conflict

Drought, population migration, and political instability resulted in civil war in Darfur. This war was described as the world's first climate change conflict by UN Secretary General Ban Ki Moon in 2007²² and has been estimated as the cause of several hundred-thousand deaths.²³ Conflict-caused destruction of public health infrastructure increases risk, incidence of disease, and reduced access to health care. The challenge to the international community presented by internal/intrastate conflict is that, unlike war between states, international humanitarian and military law does not readily enable response and protection to affected populations, yet the consequences upon a population are equally severe. Internal conflict is a chronic, smoldering problem that systematically destroys public health infrastructure and protections.²⁴

While conflict is not a new cause of population displacement, conflict due to climate change has emerged as a new, non-traditional driver of conflict, population migration, and displacement.

Limitations of the Report

The causal effects of disasters are multi-faceted, inter-related, and contextual. This paper examines the key literature used to inform the WADEM Climate Change Position Statement and reports on the process undertaken for its development, which, as an organizational consensus statement, may be biased in the views expressed given the membership's beliefs.

A comprehensive literature review is beyond the scope of this paper, which is not intended to report on the systematic reviews of the literature relative to climate change and disaster that are available from other sources.

Conclusion

The WADEM Climate Change Position Statement demonstrates the organizational commitment to health and effort to reduce disaster effects on populations. Importantly, WADEM recognizes the increasing effect of climate change on disaster risk as an issue of global concern and the increasing impact of climate-related factors in contemporary disasters. It is incumbent upon the international community to recognize climate change as an influencing and intensifying driver of disasters and to engage in scientific efforts to uphold global health security.

References

1. FitzGerald GJ, Tarrant M, Aitken P. *Disaster Health Management: A Primer for Students and Practitioners*. United Kingdom: Taylor & Francis; 2016.
2. WADEM Climate Change Position Statement. *Prehosp Disaster Med*. 2017; 32(4):351.
3. The Sphere Project. *Humanitarian Charter and Minimum Standards in Disaster Response*. Geneva, Switzerland: The Sphere Project; 2004.
4. UNISDR. *Sendai Framework for Disaster Risk Reduction 2015 - 2030*. 9-11 Rue de Varembe CH 1202, Geneva, Switzerland: UNISDR; 2015.
5. United Nations Office for Disaster Risk Reduction. *Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters*. Geneva, Switzerland: UNODRR; 2005.
6. Intergovernmental Panel on Climate Change. *Climate Change 2014-Impacts, Adaptation and Vulnerability: Regional Aspects*. New York USA: Cambridge University Press; 2014.
7. Costello A, Abbas M, Allen A, et al. Managing the health effects of climate change. *Lancet*. 2009;373(9676):1693-1733.
8. Watts N, Adger WN, Agnolucci P, et al. Health and climate change: policy responses to protect public health. *Lancet*. 386(10006):1861-1914.
9. Watts N, Adger WN, Ayeb-Karlsson S, et al. The Lancet Countdown: tracking progress on health and climate change. *Lancet*. 2017;389(10074):1151-1164.
10. UNISDR. The Human Cost of Natural Disasters: A Global Perspective. 2015. <https://reliefweb.int/report/world/human-cost-natural-disasters-2015-global-perspective>. Accessed February 1, 2018.
11. Horton R, Beaglehole R, Bonita R, Raeburn J, McKee M, Wall S. From public to planetary health: a manifesto. *Lancet*. 383(9920):847.
12. World Health Organization. Risk Reduction and emergency preparedness. WHO six-year strategy for the health sector and community capacity development. 2007. http://www.who.int/hac/techguidance/preparedness/emergency_preparedness_eng.pdf. Accessed February 1, 2018.
13. Bearne ADA. The Future of Historic Districts: A Model for Protecting Our Past from Climate Change. 2016. <https://drum.lib.umd.edu/handle/1903/18881>. Accessed February 1, 2018.

14. Bedford R, Bedford C. "International migration and climate change: a post-Copenhagen perspective on options for Kiribati and Tuvalu." In: Burson B, (ed). *Climate Change and Migration: South Pacific Perspectives*. Institute of Policy Studies, Victoria University of Wellington, New Zealand: 2010; 89.
15. World Health Organization. Protecting the health of vulnerable people from the humanitarian consequences of climate change and climate related disasters. 6th session of the Ad Hoc Working Group on Long-Term Cooperative Action under the Convention (AWG-LCA 6); 2009.
16. Centre UNN. "UN aid chief urges global action as starvation, famine loom for 20 million across four countries." Geneva, Switzerland: United Nations. <http://www.un.org/apps/news/story.asp?NewsID=56339#.WM43yBKGNg>. Accessed February 1, 2018.
17. United Nations. *World Urbanization Prospects: The 2014 Revision, Highlights*. Department of Economic and Social Affairs. Population Division; United Nations; 2014.
18. United Nations. Report of the World Commission on Environment and Development. <http://www.un-documents.net/wced-ocf.htm>. Accessed February 1, 2018.
19. United Nations. Report of the World Summit on Sustainable Development. <http://www.un-documents.net/aconf199-20.pdf>. Accessed February 1, 2018.
20. United Nations General Assembly. Resolution adopted by the General Assembly on September 25, 2015. Washington, DC USA: United Nations; 2015.
21. United Nations Development Programme. 2006. <http://www.undp.org/content/undp/en/home.html>. Accessed February 1, 2018.
22. Ki-Moon B. A climate culprit in Darfur. *Washington Post*. 2007;16:A15.
23. Degomme O, Guha-Sapir D. Patterns of mortality rates in Darfur conflict. *Lancet*. 2010;375(9711):294-300.
24. Burkle FM Jr., Martone G, Greenough PG. The changing face of humanitarian crises. *Brown J World Affairs*. 2014;20(11):25-42.

5.9.4 Discussion

The '*Protecting the health of vulnerable people from the humanitarian consequences of climate change and climate related disasters*' paper was submitted to the Inter-Agency Standing Committee Task Force on Climate Change by the World Health Organization in 2009. Five policy directions designed to protect and enhance human health and well-being from the risks of climate change were proposed which included strengthening of public health systems, enhancing capacity to address public health emergencies, strengthening surveillance and control of infectious disease, improving the use of early warning systems by the health sector, and enhancing local public health interventions to enhance community resilience to climate-change and climate-related disasters[106].

The effects of climate change are an emerging risk to health and have bearing upon sustainable development, disaster risk reduction, and health agendas. Climate change and its relationship to disaster is clearly articulated in the Sendai Framework for Disaster Risk Reduction which identifies the importance of climate change and disaster risk reduction. The Sendai Framework calls for 'addressing climate change as one of the drivers of disaster risk' and that 'more dedicated action needs to be focused on tackling underlying disaster risk drivers, such as the consequences of poverty and inequality, climate change and variability'[26]. The focus of the Sendai Framework for action in respect to climate change is specifically related to disaster risk assessment. This is noteworthy in that it articulates the relationship between climate change and disaster risk and sets the tone of policy relationship between the Sendai Framework for Disaster Risk Reduction and the United Nations Framework Convention on Climate Change Paris Agreement[15]. This clarity assists in defining the scope of the Sendai Framework and identifying the need for collaboration in disaster risk assessment and management across policies and sectors.

The Intergovernmental Panel on Climate Change fifth assessment described four climate change impact categories associated with contemporary disasters: reduced food yields due to drought, increased morbidity and mortality due to extreme heat waves, fire and extreme weather events; and, changes in infectious disease geographical spread and seasonal variation due to alterations in weather and vector distribution[102].

Climate change was described by the Lancet Commission in 2009 as "the biggest global health threat of the 21st century"[107]. Findings from the 2017 Lancet Countdown on Health and Climate Change noted a 46% increase in the frequency of weather-related disasters since the year 2000. Indicator 1.4 of the lancet Countdown '*Lethality of weather related disasters*' found no clear trend in lethality of weather related disasters in this time period however 90% of disasters in the last 20 years have been associated with weather related events[98]. Importantly the burden of deaths associated with disasters caused by natural hazards predominantly affect poorer countries[27], and the ability and responsibility of health professionals as public health advocates in ensuring action on climate change is proposed in the Lancet Countdown[98].

The Lancet Commission on Health and Climate Change initiated five thematic workgroups to develop and monitor health impact due to climate change[108]. These thematic areas

included: climate hazards; health resilience and adaptation; health co-benefits of climate change mitigation; economics and finance; and political and broader engagement; and found that the impact of global warming on human health was a health emergency[108].

Many countries within Oceania are at high risk to the effects of natural hazards. Climate change, considered in context as a driver or amplifier of natural disasters or independently considered to be a disaster is of direct relevance to this region. The World Resources Institute Aqueduct Floods Methodology report forecasts a global doubling of persons impacted by floods by 2030 affecting greater than 140 million people [109]. Causal factors cited by the report include climate change and poor land use planning in at risk areas of flooding. Of note and in respect to Oceania the highset predicted impact areas include in south and south-east Asia, including in Bangladesh, Vietnam, India, Indonesia and China, where large populations are vulnerable [109].

The Lancet Commission reported climate change as “the biggest global health threat of the 21st century” [98]. This research investigated perceptions of current and emerging disaster risk in Oceania [92]. The majority of respondents resided in Australia. They associated climate change as a primary current and emerging disaster risk that threatens the safety and security of communities. Climate change has been identified as future hazard in Australia [60]. The National Strategy for Disaster Resilience has included climate change within its scope following the 2008 Australian Prime Minister’s National Security Statement [9, 61].

The Sendai Framework for Disaster Risk Reduction notes the importance of climate change, identifying it as a driver of disaster risk and articulates its relationship to disaster risk reduction and disaster risk assessment with a specific call for action on climate change and variability [26]. This policy tone indicates the relationship between the Sendai Framework for Disaster Risk Reduction and the United Nations Framework Convention on Climate Change Paris Agreement, and is demonstrative of the need for collaboration across disciplines and practice for comprehensive disaster risk reduction activities [26, 110]. Moreover, and directly related to the Oceania region, The Sendai Framework for Disaster Risk Reduction specifically identifies the vulnerability and risk of small island states for particular attention [26].

The findings of this study are consistent with previous research describing the health impacts of climate change. The fifth assessment report of the Intergovernmental Panel on Climate Change (IPPC) has identified injuries, hospitalisation and deaths due to intense heat waves, fires and other weather disasters and changes in patterns and impacts of infectious disease [102]. Importantly the report notes that populations with low socio-economic status and pre-existing vulnerabilities are at greater risk of the impacts of climate change. Specific risks posed by climate change to populations in Oceania resulting in climate refugees have been previously reported by Weir et al who noted the intersection of climate change, conflict and disaster [111].

There is overlap between disaster risk reduction and adaption to climate change strategies. The increasing severity and intensity of natural disasters impacts many communities sensitive to changes in climate. Whilst disaster risk reduction embodies an ‘all hazards’

approach, focus on climate change adaptation strategies is required where socio-economic vulnerability is increased due to climate change.

Climate change is perceived as a significant contemporary and future disaster risk in the Oceania region. Strategies for action identified by respondents in this research include improved government and community engagement in risk understanding, ownership and mitigation, and improved understanding of the long-term effects of disaster impact upon human health.

The World Association of Disaster and Emergency Medicine (WADEM) Position Statement on Climate Change was developed by the Oceania chapter of WADEM including input from the author. The findings of this research influenced the development of the position statement and report and further Australian analysis of climate change impact which was presented and is discussed in the following chapter

This chapter explored the Climate change as a current and future emerging hazard. Climate change as a driver of disaster was a key finding in this thesis, and unique insights into how climate change was shaping disaster risk in Oceania were identified. The following chapter explores Volcano risk in Oceania, identified by research respondents as a significant hazard in Oceania.

5.10 Volcano Risk in Oceania

5.10.1 Introduction

One of the major risks identified through research conducted in this thesis in Oceania and the Pacific was Volcano. This paper reports on the health impacts related to Volcano hazards to support the abstract presentation by the WADEM Oceania chapter at the World Congress of Disaster and Emergency Medicine in Brisbane 2019. The health impacts related to Volcano hazards are of particular importance to populations in Oceania, this report seeks to illuminate the findings of the WADEM Oceania chapter to the scientific community. The paper should be of interest to readers in the areas of health impacts and disaster risk reduction.

WADEM recognises its responsibility as a multi-disciplinary leader in health to provide guidance and engage in disaster risk reduction. The intent of this paper was to illuminate the global disaster risk to health presented by volcanoes.

5.10.2 Peer reviewed published paper: Health Impacts of Volcanic Activity in Oceania

Health Impacts of Volcanic Activity in Oceania

Joseph Cuthbertson, MPH, MSC, MEH;¹  Carol Stewart, PhD;² Alison Lyon, MBChB, MS, FRACGP;³ Penelope Burns, BMed, MPHTM;⁴ Thompson Telepo, BNurs⁵

1. Monash University Disaster Resilience Initiative, Clayton, Melbourne, Victoria, Australia
2. College of Health, Massey University, Palmerston North, Manawatu-Wanganui, New Zealand
3. Western Sydney University, Penrith South, New South Wales, Australia
4. Australian National University, Canberra, Australian Capital Territory, Australia; Western Sydney University, Penrith South, New South Wales, Australia
5. University of Papua New Guinea (UPNG), Port Moresby, Papua New Guinea

Correspondence:

Joseph Cuthbertson, MPH, MSC, MEH
30 Sixth Avenue Kensington 6151 WA
Australia
E-mail: Joseph.Cuthbertson@monash.edu.au

Conflicts of interest: none

Keywords: disaster; hazard; health impacts; Oceania; volcano

Abbreviations:

IDP: internally-displaced person
NGO: nongovernmental organization
PNG: Papua New Guinea
WADEM: World Association for Disaster and Emergency Medicine

Received: March 23, 2020

Accepted: April 15, 2020

doi:[10.1017/S1049023X2000093X](https://doi.org/10.1017/S1049023X2000093X)

© World Association for Disaster and Emergency Medicine 2020.

Abstract

Volcanoes cause a wide range of hazardous phenomena. Close to volcanic vents, hazards can be highly dangerous and destructive and include pyroclastic flows and surges, ballistic projectiles, lava flows, lahars, thick ashfalls, and gas and aerosol emissions. Direct health impacts include trauma, burns, and exacerbation of respiratory diseases. Far-reaching volcanic hazards include volcanic ashfalls, gas and aerosol dispersion, and lahars. Within Oceania, the island arc countries of Papua New Guinea (PNG), the Solomon Islands, Vanuatu, Tonga, and New Zealand are the most at-risk from volcanic activity. Since 1500AD, approximately 10,000 lives have been lost due to volcanic activity across Oceania, with 39 lives lost since 2000. While volcano monitoring and surveillance save lives, residual risks remain from small, sudden, unheralded eruptions, such as the December 9, 2019 eruption of Whakaari/White Island volcano, New Zealand which has a death toll of 21 at the time of writing. Widespread volcanic ashfalls can affect the habitability of downwind communities by contaminating water supplies, damaging crops and buildings, and degrading indoor and outdoor air quality, as well as disrupting transport and communication networks and access to health services. While the fatality rate due to volcanic eruptions may be low, far greater numbers of people may be affected by volcanic activity with approximately 100,000 people in PNG and Vanuatu displaced since 2000. It is challenging to manage health impacts for displaced people, particularly in low-income countries where events such as eruptions occur against a background of low, variable vaccination rates, high prevalence of infectious diseases, poor sanitation infrastructure, and poor nutritional status. As a case study, the 2017–2018 eruption of Ambae volcano, Vanuatu caused no casualties but triggered two separate mandatory off-island evacuations of the entire population of approximately 11,700 people. On the neighboring island of Santo, a health disaster response was coordinated by local government and provided acute care when evacuees arrived. Involving primary care clinicians in this setting enhanced local capacity for health care provision and allowed for an improved understanding of the impact of displacement on evacuee communities.

Cuthbertson J, Stewart C, Lyon A, Burns P, Telepo T. Health impacts of volcanic activity in Oceania. *Prehosp Disaster Med.* 2020;35(5):574–578.

Introduction

The World Association for Disaster and Emergency Medicine (WADEM; Madison, Wisconsin USA) is a multidisciplinary professional association whose mission is the global improvement of prehospital and emergency health care, public health, and disaster health and preparedness.¹ WADEM recognizes its responsibility as a multidisciplinary leader in health to provide guidance and engage in disaster risk reduction. The development of this WADEM Oceania Special Report on the Health Impacts of Volcanic Activity was undertaken by the WADEM Oceania Chapter who are cognizant of the threat that active volcanism poses to population health and livelihood in the Asia-Pacific region.

Following a structured session dedicated to investigation of health impacts of volcanic activity in Oceania at the WADEM Congress on Disaster and Emergency Medicine (WCDEM) Brisbane 2019, the WADEM Oceania Chapter developed this Special Report. The target audience for this Special Report includes WADEM members, readers of *Prehospital and Disaster Medicine*, and the global disaster health community.

Volcanoes of Oceania

The Pacific “Ring of Fire” is a horseshoe-shaped zone surrounding the Pacific Ocean where a concentration of volcanic and earthquake activity occurs (Figure 1).² Much of the volcanic

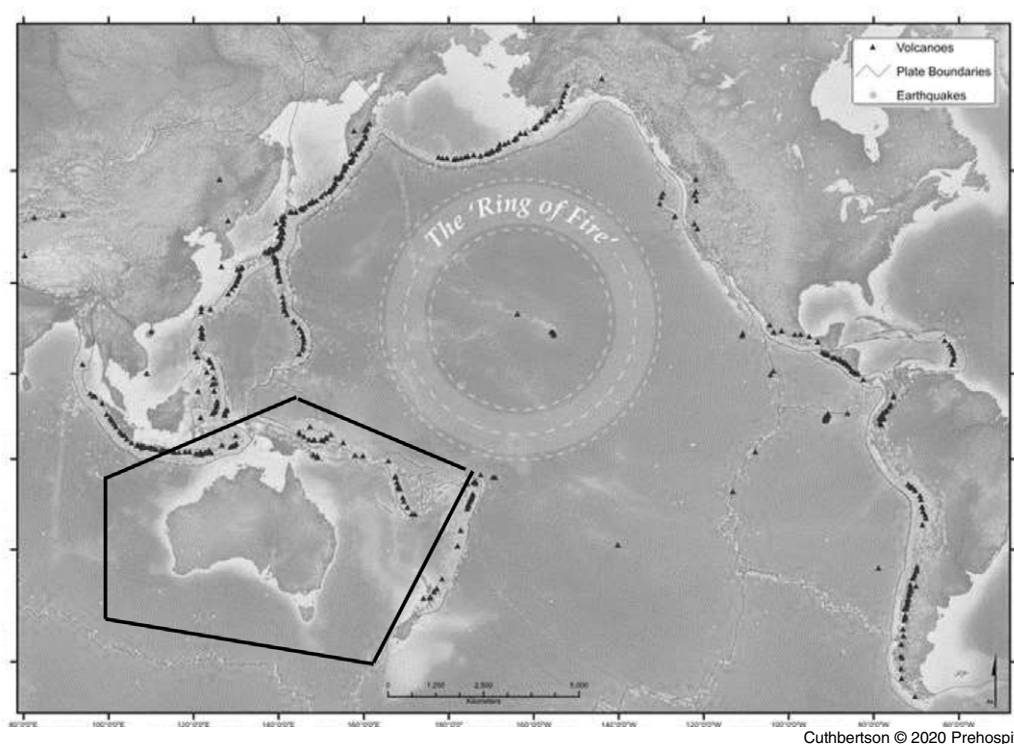


Figure 1. The Pacific Ring of Fire² with Oceania Region Outlined.

activity is associated with subduction zones, which are convergent boundaries between tectonic plates. Subduction zones form when continental and oceanic crust collide. Thinner, denser oceanic crust is less buoyant than continental crust, so it sinks (subducts) beneath the continental crust. At depths of approximately 80km-160km, partial melting occurs to generate magma, which migrates upwards and may reach the Earth's surface to produce volcanic landforms. Subduction zones generally produce volcanic arcs.

In the Oceania region, the island arc countries of Papua New Guinea (PNG), the Solomon Islands, Vanuatu, Tonga, and New Zealand (Figure 1) are most at-risk from active volcanism.³ These countries contain active, explosive-type volcanoes that have produced major eruption crises in modern times. Recent examples are the 1951 eruption of Lamington volcano, PNG where pyroclastic flows swept down all sides of the volcano, killing an estimated 2,942 people; and the 1937 eruption of Rabaul volcano, PNG where 507 people were killed by pyroclastic surges and ashfall. Overall, since 1500AD, there have been ~9,300 volcanic fatalities recorded in Oceania due to volcanic activity (Table 1).⁴

Near-Vent Volcanic Hazards

Volcanoes are unique among natural hazards in that they can cause a wide range of hazardous phenomena. Close to volcanic vents, hazards can be highly dangerous and/or destructive to property and include pyroclastic flows and surges, ballistic projectiles, lava flows, lahars, thick ashfalls, debris avalanches, and gas and aerosol emissions.

A range of approaches is used to reduce volcanic risks to life safety. These include volcano monitoring and surveillance, land-use planning, warning systems, hazard maps, and public education

campaigns. Following the 1937 eruption of Rabaul volcano, which was unmonitored at the time, a permanent observatory was established in 1940. It was destroyed during WWII and re-established in 1950. An unrest crisis during 1983-1985 was valuable in spurring preparedness efforts, particularly the development of a contingency plan that identified evacuation routes out of the area and safe refuges, as well as public education on the volcanic hazard.³ The value of these efforts became apparent in 1994/1995 when a powerful explosive eruption forced the temporary abandonment of Rabaul City: approximately 100,000 residents evacuated their homes, but only five lives were lost.³

While volcano monitoring and surveillance (and associated measures) have demonstrably saved lives, residual risks remain, particularly from small, sudden, unheralded eruptions which may be deadly at close range. Since 2000, 39 lives have been lost due to volcanic activity in Oceania (Table 2). This catalogue is dominated by the December 9, 2019 eruption at Whakaari volcano, New Zealand, with the death toll at 21 at the time of writing.⁵

Far-Reaching Volcanic Hazards

Volcanic ashfall is generated by all explosive eruptions, dispersed by prevailing winds, and may be deposited on communities and farmland hundreds or even thousands of kilometers away.⁶ The wide geographic reach of ashfalls, and sometimes also volcanic gases and aerosols, make them the volcanic hazard most likely to affect the greatest numbers of people.⁷ Lahars (volcanic mudflows) can also affect areas further away (typically tens of kilometers) from volcanoes, as they travel down river systems.

Ashfalls are generally disruptive rather than damaging, but occasionally they can cause fatalities. Following the eruption of Manam

Country	Number of Fatalities
New Zealand	359
Papua New Guinea	7329
Solomon Islands	1322
Tonga	36
Vanuatu	246
Oceania total	9292
World	278,389

Cuthbertson © 2020 Prehospital and Disaster Medicine

Table 1. Volcanic Fatalities in Oceania since 1500AD, by Country³

Year	Country	Volcano	Type of Volcano	Number of Fatalities	Fatal Cause
2019	New Zealand	Whakaari/White Island	Stratovolcano	21	Eruption while tourist group in crater ^a
2015	New Zealand	Rotorua	Caldera	1	Non-eruptive: indirect
2013	New Zealand	Rotorua	Caldera	1	Non-eruptive: gas
2010	New Zealand	Rotorua	Caldera	1	Non-eruptive: indirect
2008	New Zealand	Rotorua	Caldera	1	Non-eruptive: gas
2007	New Zealand	Rotorua	Caldera	1	Non-eruptive: gas
2006	New Zealand	Raoul Island	Stratovolcano	1	Eruption
2005	Papua New Guinea	Manam	Stratovolcano	1	Tephra
2004	Papua New Guinea	Manam	Stratovolcano	5	Tephra
2004	Papua New Guinea	Manam	Stratovolcano	4	Lahars
2003	New Zealand	Rotorua	Caldera	1	Non-eruptive: gas
2000	New Zealand	Rotorua	Caldera	1	Non-eruptive: gas
Total	Oceania			39	

Cuthbertson © 2020 Prehospital and Disaster Medicine

Table 2. Fatal Incidents in Oceania since 2000^{3,4}^aThis event is under active investigation. Likely fatal cause is a base surge. Number of fatalities is at time of writing.⁵

volcano, PNG in late 2004, five people (two elderly people and three children) died from respiratory complications following ash inhalation (Table 2).^{4,8} A further four people died and one was injured by a lahar in the valley on the north side of the island.⁴ The following year, 14 people were injured and one killed by heavy ashfalls in Warisi village on the eastern side of Manam island, reportedly due to buildings collapsing under the weight of the debris,^{4,9} as well as burning down due to the hot debris.

More commonly, ashfalls can affect the habitability of down-wind communities, including aspects such as contamination of drinking-water supplies, degradation of outdoor and indoor air quality, damage to buildings, crop damage, and food security. These aspects of environmental health can be important drivers of evacuation decisions, particularly if impacts are sustained. As shown in Table 3, since 2000, nearly 100,000 people across Oceania have been displaced by volcanic ashfall, with approximately two-thirds in PNG and one-third in Vanuatu.¹⁰ Forced migrations and protracted displacements bring insecurity, the potential for politicization of the population, and can be drivers of instability in the region. This applies to both the community that has to relocate as well as the host community. Internally-displaced persons (IDPs) place pressure on resources, job opportunities, food, health access, and civil and political rights.

In the following section, the recent 2017–2018 Ambae eruption, which caused the entire population of the island to be evacuated twice, is discussed.

Year	Country	Affected
2001	Vanuatu	4,500
2002	Papua New Guinea	13,000
2004	Papua New Guinea	9,600
2005	Papua New Guinea	15,000
2005	Vanuatu	5,000
2006	Papua New Guinea	3,299
2008	Vanuatu	9,000
2009	Vanuatu	400
2014	Papua New Guinea	1,380
2017	Vanuatu	11,670
2018	Papua New Guinea	736
2018	Vanuatu	7,286
2019	Papua New Guinea	15,800
Total	Oceania	96,671

Cuthbertson © 2020 Prehospital and Disaster Medicine

Table 3. Numbers of People Displaced by Volcanic Ashfall in Oceania, 2000–2020

Case Study: The 2017–2018 Ambae Eruption, Vanuatu

The island of Ambae is a massive basaltic shield volcano that is the largest by volume in the Vanuatu archipelago. The volcano is also



Cuthbertson © 2020 Prehospital and Disaster Medicine

Figure 2. Heavy Ashfall Damage to Crops, South Ambae (~150mm ashfall depth).

Photo Credit: Ame McSporran.

known locally at Manaro or Manaro Voui. The 2017–2018 explosive, multi-phase Ambae eruption occurred in four main phases. The first of these (September–November 2017) triggered a mandatory evacuation of the entire population of the island's 11,670 residents, primarily due to fears of eruption escalation, with the island repatriated by the start of November 2017. Phase 2 (December 2017–February 2018) and Phase 3 (March–April 2018) produced thick ashfalls and acid rain to the west and south of the island. However, these were able to be managed within-island, by evacuating people from the most-affected zones to evacuation centers at the relatively-unaffected eastern end of the island. Information was also provided to residents in less-affected areas on volcanic ash, gas and acid rain hazards, and how to minimize their impacts. Phase 4, from July–November 2018, brought further thick ashfalls to the west, east, and southeast, causing major damage to crops, water supplies, and traditional buildings, and prompting another mandatory whole-island evacuation from the end of July until the end of October 2018 when volcanic activity ceased.

A government-sponsored “second home” scheme for evacuees was set up on the neighboring island of Maewo, whereby Ambae residents were provided with access to land, shelter and building supplies, food, and water, while still keeping their land on Ambae. Approximately 3,000 Ambae residents evacuated to Maewo under this scheme, with other Ambae residents self-evacuating to other islands in Vanuatu, primarily to the neighboring island of Santo. As of March 2019, 4,178 people had returned to Ambae,¹¹ and by February 2020, the Ambae Council of Chiefs estimated that 80% of the population had returned home.¹²

Environmental health consequences of the ashfalls were assessed through visits from multi-agency field teams from Vanuatu, New Zealand, and Singapore, and assistance from local agency staff and community members. Ash contamination of water supplies was a major problem for Ambae, along with severe damage to food crops (Figure 2) and traditional buildings by thick ashfalls. Across the whole island, 22% of traditional buildings completely collapsed (Figure 3) at ash thicknesses as low as 4cm depth.¹³ In some villages, up to 50% of traditional buildings collapsed.¹³ No



Cuthbertson © 2020 Prehospital and Disaster Medicine

Figure 3. Complete Collapse of an Open-Sided Traditional Building (55mm ashfall depth).

Photo Credit: Susannah Jenkins, Earth Observatory of Singapore.

modern buildings, typically constructed of reinforced breeze blocks with metal roofs, collapsed, although sagging and collapse of rain gutters was common.¹³ Ashfall also contaminated roof catchment rainwater tanks and other open-air tanks (Figure 4) with 26 out of a total of 33 drinking-water samples analyzed exceeding drinking-water guidelines for fluoride, aluminum, copper, manganese, and zinc.¹⁴

Approximately 6,000 Ambae residents voluntarily evacuated to Santo,¹⁵ where a health disaster response was coordinated by the local government. This involved recruiting health care workers from a nongovernmental organization (NGO) primary care clinic to provide acute care on-arrival to the island and on-going care in the community. An NGO primary care team comprised of a General Practitioner, Nurse Practitioner, and two health care assistants undertook initial assessment of a group of newly arrived evacuees. This allowed identification and management of urgent care needs.

Over the subsequent weeks, the primary care clinic provided care to the evacuees. A prospective database of anonymized case files was undertaken to monitor evolving primary health care needs of the evacuee community. Twenty-five patients were assessed by the initial team. Two patients required urgent transfer to emergency department for acute management. There were six diabetic patients who required medication supplies. There were eight hypertensive patients, of which two required urgent blood pressure reduction and four required medication supplies. Over the following two weeks, 104 patients were reviewed at the clinic. During this time, 45 patients were treated for respiratory tract infections. Medication supplies were replenished for antihypertensives and diabetic medications for seven patients. Opportunistic cardiovascular and diabetes risk reviews were performed and follow-up arranged for nine patients.

Involving local primary care clinicians in this setting enhanced local capacity for health care provision. Patients were able to receive continuity of care for their acute and on-going medical problems. Involving primary care clinicians in disaster management allows



Cuthbertson © 2020 Prehospital and Disaster Medicine

Figure 4. Village Well Contaminated with Ashfall after Protective Metal Sheets Collapsed, South Ambae.

opportunity to evaluate evolving care needs and gain an improved understanding of the impact of displacement on the community.¹⁶

Conclusion

This report summarizes the WDEM 2019 Brisbane conference Oceania chapter session focusing on the health impacts of volcanic activity. Since 2000, 39 lives have been lost in Oceania due to volcanic activity (in PNG and New Zealand), but a far larger number (~100,000) have been displaced by volcanic ashfall (in PNG and Vanuatu). Managing large numbers of IDPs is challenging for these developing countries. The priority for health response is restoration of safe, accessible health services for the affected population. This can be affected by local health workers also being

affected and losing homes. Disasters occur against a background of variable low vaccination coverage rates, high prevalence of infectious diseases, and poor nutritional status of under-fives, which creates a higher risk of infectious disease outbreaks. Effective responses may include prioritization of routine vaccination with nutritional support for children; support of women of childbearing age, including those pregnant and lactating; re-establishment of health care centers, subcenters, and hospitals; provision of medical kits and supplies; and additional mental health care trained workers. Such efforts align with Priority 2 of *The Sendai Framework for Disaster Risk Reduction*, “Strengthening disaster risk governance to manage disaster risk.”¹⁷

References

- Fitzgerald GJ, Tarrant M, Aitken P. *Disaster Health Management: A Primer for Students and Practitioners*. United Kingdom: Taylor & Francis; 2016.
- Earth Observatory of Singapore. Singapore: Asian School of the Environment. <https://www.earthobservatory.sg/resources/maps/ring-fire>. Accessed February 11, 2020.
- Secretariat of the Pacific Community. Volcanic hazards and emergency management in the Southwest Pacific. SPC Technical Bulletin SP00017. 2016; Suva, Fiji.
- Brown SK, Jenkins SF, Sparks SJ, Odbert H, Auker MR. Volcanic fatalities database: analysis of volcanic threat with distance and victim classification. *Journal of Applied Volcanology*. 2017;6:15.
- Ministry of Health Manatū Hauora, New Zealand. Whakaari/White Island: final patients discharged from National Burn Centre. <https://www.health.govt.nz/our-work/emergency-management/whakaari-white-island-patient-status>. Accessed March 9, 2020.
- Stewart C, Wilson TM, Sword-Daniels V, et al. “Communication demands of volcanic ashfall events.” In: *Advances in Volcanology*. Berlin, Germany: Springer; 2018:23–49.
- Loughlin SC, Vye-Brown C, Sparks RS, et al. “Global volcanic hazards and risk: summary background paper for the UN-ISDR Global Assessment Report on Disaster Risk Reduction 2015.” In: Fitzgerald GJ, Tarrant M, Aitken P. *Disaster Health Management: A Primer for Students and Practitioners*. United Kingdom: Taylor & Francis; 2016.
- Global Volcanism Program, 2004. Report on Manam (Papua New Guinea). *Bulletin of the Global Volcanism Network*. 2004;29(11).
- Global Volcanism Program, 2005. Report on Manam (Papua New Guinea). *Bulletin of the Global Volcanism Network*. 2005;30(2).
- Universite Catholique de Louvain (UCL) - CRED, D. EM-DAT: The Emergency Events Database. Guha-Sapir. www.emdat.be. Accessed March 9, 2020.
- Ambae Evacuee Response, Vanuatu: Ambae Returns as of 2019-03-18. <https://reliefweb.int/report/vanuatu/ambae-evacuee-response-vanuatu-ambae-returns-2019-03-18>. Accessed March 13, 2020.
- Ligo G. Ambae Chiefs: 80% of Evacuees Have Returned Home. https://dailypost.vu/news/ambae-chiefs-of-evacuees-have-returned-home/article_3db5ebc0-4ea8-11ea-9312-0396eb5d41ea.html. Accessed March 13, 2020.
- McSporran AM. Impacts of tephra fall on buildings from the 2017-2018 eruption of Manaro Voui volcano, Ambae Island, Vanuatu. 2019. MSc Thesis; University of Canterbury, New Zealand. <https://ir.canterbury.ac.nz/handle/10092/18600>. Accessed March 13, 2020.
- Stewart C. Unpublished data.
- Vanuatu National Disaster Management Office. NEOC Situation Report 18; August 22, 2018. <http://www.ndmo.gov.vu/resources/downloads/category/62-situation-reports>. Accessed March 13, 2020.
- Burns PL, Douglas KA, Hu W. Primary care in disasters: opportunity to address a hidden burden of healthcare. *Med J Aust*. 2019;210(7).
- United Nations. *Sendai Framework for Disaster Risk Reduction 2015–2030*. Sendai, Japan: World Conference on Disaster Risk Reduction; 2015.

5.10.3 Discussion

This paper describes the health impacts of a specific disaster type (Volcano) in Oceania. Whilst there is evidence of emerging disaster risks in Oceania it is important to note the presence of a natural hazard profile such as this continues to challenge populations in the region that live with these threats. The future state of health of these communities will be determined by how well we identify and reduce existing and future risks.

5.11 STAGE 1 DISCUSSION

This research provided a focussed analysis of disaster risk in Oceania and examined the previous impacts caused by hazards creating disaster.

Discussion of Stage 1 research activities has been progressively incorporated in the outputs of peer reviewed papers produced as outputs of this stage. This research uncovered that such methods of data capture are not sensitive to signalling new and emerging risk to inform preparation and preparedness. Further to this, new knowledge on how disaster impact is defined showed that non-traditional health threats which are currently the cause of impact criteria that meet and exceed contemporary disaster definitions, are not measured, reported or described as such. This represents a missed opportunity to consider preparedness, planning, response and recovery counter measures for such threats and impacts with a disaster risk reduction lens. This research had strengths and weaknesses associated with findings reported.

5.11.1 Strengths

The strengths of the design and methods applied in this research project are the use of mixed methods to explore objectives and formulate recommendations and conclusions. Themes developed from participant engagement were compared to existing data related to the research aims to identify gaps in knowledge belief and/or practice.

5.11.2 Weaknesses including potential bias

Challenges noted during the research were associated with more information being found in the “grey literature” and in humanitarian practice than in peer reviewed literature. Variance in terminology of definitions, for example ‘resilience’ is used by a variety of academic fields in different contexts. Whilst Utstein guidelines for research and evaluation in disasters have been produced[112], definitions are applied inconsistently across disaster practice. The diversity of the disaster peer reviewed literature, as evidenced by a study conducted by Smith et al. identified nearly 2,000 peer reviewed, event specific publications that have been published in 789 journals[113].

Weaknesses identified in publication of results associated with research project one included limited data related to Pacific respondents. Further data gathering and analysis was undertaken to address this and included in the thesis writings.

5.12 STAGE 1 CONCLUSION

In this chapter, extended research was sought to understand risk perception of emerging threats in the Oceania region with a specific focus of countries in the Pacific. It was noted by reviewer feedback of published article 'Current and Emerging Disaster Risks Perceptions in Oceania' that investigation of this area was recommended. As such investigation seeking to understand and explore perceptions of disaster risk and emerging threats in this region was undertaken.

This stage has addressed research question 1: 'What are the profiles of emerging disaster risks in Oceania?' This stage found that current and emerging disaster risks threaten the health status of communities in Oceania. Of these risks climate change is a driver of increased frequency and intensity of weather-related hazards in the region.

This stage of research profiled pre-existing and emerging threats to health and well-being in Oceania and demonstrated the connected systemic nature of disaster risk. Reducing hazards should be addressed as a function of everyday community practice, not an intermittent activity or as action prescribed to them. The next stage of research explored non-traditional health threats and sought to further understand linkages between health status and disaster risk.

6. STAGE 2 THE SOCIAL DETERMINANTS OF HEALTH IN DISASTER RISK REDUCTION

6.1 INTRODUCTION

The previous chapter investigated emerging disaster risk in Oceania. This chapter explores linkage between the Social Determinants of Health and Disaster Risk Reduction. This is a unique area of study at an international level, as the relationship between disaster risk and health status is poorly understood.

The effects of disasters disproportionately affect vulnerable groups within communities[20]. Marginalised populations due to gender, age, disability, ethnicity, religion or sexual orientation are at greater risk to the impact of a disaster[21]. The concept of examining the causal factors of health and addressing them resonates well with contemporary disaster risk reduction practice. Whilst disaster practice to date has predominantly focussed on emergency management, new thinking proposes that investment in reduction, addressing vulnerability and improving community capacity provides a greater return on investment[20]. A view reinforced by the 2020 Royal Commission into National Natural Disaster Arrangements[114].

This research examined whether appropriate disaster risk reduction practice is a determinant of population health, and that once established the Social Determinants of Health could act as a framework which Disaster practice uses to ensure actions are effective in improving community health status.

This stage explores the use of the Social Determinants of Health in contemporary disaster management practice by examining non-traditional threats to health, and using the Social determinants as a lens for assessing perceptions of disaster resilience. Outputs of research conducted in this stage included peer reviewed papers describing non-traditional health threats and societal disruption.

6.2 STUDY 2: WESTERN AUSTRALIAN COMMUNITY STUDY, HEALTH AND DISASTER RISK

6.2.1 Introduction

The previous studies explored current and emerging risks and specific disaster types. This study undertook a focussed exploration of a community's view on the relationship between health and wellbeing and disaster risk.

6.2.2 Rationale

The rationale for undertaking Study 2 was to investigate how causal factors of population health relate to, and impact upon disaster risk, resilience, vulnerability, impact and recovery. The multi-disciplinary environment that contextualises disaster practice has the

capacity to influence determinants of health. Current responses to address disaster risk independently by disciplines may be redundant or, at worst, conflicting. Identification of this influence, and coordination of programmed effort between disciplines has the potential to enhance societal wellbeing and reduce the human and economic costs associated with disasters.

6.2.3 Design

The design of Study 2 was qualitative, thematic analysis of semi-structured face to face interviews with community members in an area with a pre-existing identified disaster risk. This utilised a theme list informed by the literature review. The interviews were recorded, transcribe from which thematic analysis was undertaken.

6.2.4 Literature review and research questions

A literature review was undertaken for this theme in two parts:

A review of the peer reviewed literature tracing the development of disaster risk and health was undertaken between the dates of 1990 and 2015. The following databases were searched: PubMed/Medline; Cinahl Plus; EMBASE; Proquest; Science Web; Scopus and Web of Knowledge. Searches were made utilising the terms; 'disaster resilience', 'health', 'disaster health,' 'social determinants of health,' and 'disaster risk reduction. The following criteria were used to identify material that would be included: published in peer reviewed journal and published in the English language. Exclusion criteria included: non peer reviewed papers and abstracts.

A review of the "grey literature" using similar key words, date range and inclusion/exclusion criteria was undertaken. The literature review was informed by a consideration of policy related to sustainable development, the social determinants of health, and health improvement and disaster risk reduction agenda described by the World Health Organisation (WHO) and the United Nations Office for Disaster Risk reduction (UNDRR).

Key Findings

Priority one of the Sendai Framework is to understand disaster risk in all its dimensions of vulnerability, defined as the "physical, social, economic and environmental factors or processes, which increase the susceptibility of a community to the impact of hazards"[26]. Identifying and prioritising vulnerable communities aligns with the Sendai Framework which requires 'all-of-society engagement and partnership' and is consistent with the sustainable development goals and intent to 'leave no one behind' [115].

A systematic review conducted by Nomura et al explored the intersection of disaster vulnerability and Social Determinants of Health and proposed action upon identified themes to improve community resilience[116]. Twigg et al report that marginalised and disadvantaged groups suffer the worst from disasters. Those who are already at social or economic disadvantage are less able to undertake risk reduction measures, are at greater risk of impact effects, and face greater challenges to recover. Such vulnerability, associated with underlying social status is described as the 'the human dimension of disasters',

resulting from physical, social, economic and environmental factors, which are also drivers of poor health[117, 118].

Poverty has been found to be a key driver and consequence of disasters and as a consequence of this inequality in poverty will remain in poverty following disaster[119]. The unequal distribution of wealth and the increased vulnerability to adverse impacts of disasters has also been identified by Naser-Hall who advocates for poverty reduction pre impact to mitigate disaster effect[120]. This approach is consistent with the Sendai Framework for Disaster Risk Reduction by preventing new risks, reducing existing ones, and addressing underlying risk drivers to mitigate the impact of natural disasters[26]. This finding is consistent with research conducted by Winsemius et al who identified that people experiencing poverty are disproportionately exposed to natural disasters caused by floods and droughts. Findings of land scarcity as possible drivers suggest actions of policies and practices that support recommendations of developmental policies and land use planning that protects those experiencing poverty[121].

The Commission on Social Determinants of Health was established by the World Health Organisation in March 2005 to support countries and global health partners in addressing the social factors leading to ill health and health inequities. This Commission aimed to draw the attention of governments and society to the Social Determinants of Health and create better social conditions for health, particularly among the most vulnerable people. The Commission delivered its report to the World Health Organisation in July 2008 and subsequently ended its function. The report proposed three overarching recommendations: improve daily living conditions, tackle the inequitable distribution of power, money, and resources, and measure and understand the problem and assess the impact of action. Further to these 3 overarching recommendations ten elements were used to describe the Social Determinants of Health: the social gradient stress, early life experience, social exclusion, work, unemployment, social support, addiction, food and transport.

Disaster resilience, as a function of a community is a relatively new and evolving concept. Sundnes and Birnbaum have previously defined resilience as *“the pliability, flexibility, or elasticity of the population/ environment to absorb, buffer, and/ or manage the event/ damage”*; and has suggested an inverse relationship between resilience and vulnerability[112], that is:

$$\text{Vulnerability} = 1 - \text{Resilience}[112].$$

Since this time commentary on describing disaster resilience has progressed, and contemporary views suggest a broader relationship than this. Social resilience has been defined by Adger as the *‘ability of groups or communities to cope with external stresses and disturbances as a result of social, political and environmental change.’*[122, 123] Social resilience can be increased through improvements in adaptability, diversity, learning and self-organization [124, 125]. Utilising the definition of social resilience described by Adger a population’s ability to maintain/ preserve or re-establish its social system measured over time post disaster can provide an assessment of a society’s resilience[123]. The application of the principles of social resilience (adaptability, diversity, learning and self-organization)

into measurable, recovery time objectives can identify specific elements of resilience within a community. The identification of strengths or weaknesses within a community can then guide appropriate allocation of resources for capacity building.

Community competence has been described as a measure of social resilience where attributes of physical and emotional health and quality of life underpin competency[126]. Community competence has been used to measure how well the community functions pre- and post-disaster through the maintenance or reestablishment of community values and culture post event [126, 127].

Bihari and Ryan examined the influence of social capital on community preparedness for wildfires[128]. Social capital is orientated around the theory that social networks have value, and that benefits in terms of the quality of life can be derived from the cooperation between individuals and groups. Bihari and Ryan examined factors that influenced social capital in wildfire risk areas[128]. Questions investigated wildfire experience, attitude to risk, perceptions of social connectivity and cohesion, place attachment, preparedness, planning and any changes in respect to risk management. Social capital was linked to increased place attachment and previous experience; in turn this was associated with changes in preparedness actions and risk attitude. Experience however varied between respondents, and it was not known what level or amount of experience affected behaviour. This research was fire specific; examination of social capital and other disaster types would be of benefit.

Lindsay has provided an analysis of the determinants of disaster vulnerability, interestingly he claims that 'income and social status are the pivotal factors in determining disaster vulnerability', and recommends 'Britton and Walkers typology of vulnerability'[129]. Plough et al. make the connection between those communities that experience disparities during non-emergency times and the need to build resilience which in turn can strengthen a community's ability to rally from disasters[130].

The gap between disaster health practices applied in the developing country model versus that in the developed country context is broad. Human migration is closely associated with disaster impact but is often viewed as a humanitarian issue. Learning recommends that closer alliance of humanitarian practice with State and/or National Disaster practice to improve outcome of events that cause forced migration[131]. The concept of forced migration in the developed country setting is most probably not readily accepted, yet patterns of people movement in disasters would suggest that it is already occurring. Emergency management practices of 'leave early' messaging promoted in Australian bushfire response, and the movement of people living in high-risk areas to the coast on high-risk days could be described as unplanned migration, albeit temporary in nature.

Findings made by Arnold related to resilience concluded that individual characteristics of mental health and higher intelligence contribute to developmental competence[14, 132]. The effects of these resiliencies do not overcome the effects of high environmental risk[133]. This finding is interesting as the environmental risk factors identified are quite similar to the WHO determinants of health. This also aligns with Lindsay's paper who

recommends aligning disaster mitigation with Social Determinants of Health planning and applying a population health approach[129]. Lindsay also found that income and social status are the pivotal factors in determining disaster vulnerability[129], and that individuals affected by extreme poverty are often disproportionately exposed to disaster and therefore have greater vulnerability to the effects of disaster.

In 'Wildfire preparedness, community cohesion and social-ecological systems' Prior and Eriksen examine relationships between preparedness for wildfire and social cohesion[134]. In the setting of increased frequency and severity of fire in semi-rural areas in Australia recognition of risk, resilience, vulnerability and preparedness are evolving. Following a qualitative thematic analysis, a quantitative model was developed that used several measures to test association between social cohesion, connectivity, and wildfire preparedness. These were: Wildfire preparation, outcome expectancy, sense of community, action coping, self-efficacy, preparation inhibitors, and collective efficacy. Prior and Eriksen demonstrate that social connectivity enhances preparedness activities at an individual and community level. Additionally community members with poor knowledge and/or preparedness benefitted from greater social inclusiveness and support[134]. This is of particular relevance in the rural/urban fringe where resident knowledge and/or experience of wildfire risk may be poor. This research however is limited in that it was conducted in a developed nation with established infrastructure and services. The context of the developing country and whether social connectivity is associated with disaster risk reduction is not established.

Biedrzycki and Koltun review the Integration of Social Determinants of Community preparedness and resiliency in Emergency Management Planning. This article reviews The United States Department of Homeland Security's Federal Emergency Management Agency strategic planning and response to disasters. In particular the departments adoption of a 'World Health Organisation lens of community approach' in developing and describing this strategy is examined by the authors[135]. The authors highlight that this strategic approach has not adequately incorporated the multidimensional factors associated with population health that influence community and individual resilience and behaviour. Three case studies (Hurricane Katrina, BP oil spill and H1N1) are examined in relation to how impact was related to elements of the Social Determinants of Health. Examples of economic status relative to healthcare behaviour (where poverty was associated with low vaccination status); unemployment rates associated with the BP oil spill and increased domestic violence; and minority populations associated with chronic illness and increased infection vulnerability all demonstrated the gap between traditional emergency management planning and holistic community preparedness[135].

Globalisation and Social Determinants of Health by Ronald Labonté and Ted Schrecker[136] establishes, and then defends a definition of globalisation that is founded on the premise of economic development being the primary cause and driver of globalisation. As a consequence, the argument is made that this premise is a key upstream determinant of population health. The article develops and defines key areas of research and proposals to strengthen action on improvement in health as a function of globalisation. Interestingly the authors note that explicit casual relationships are difficult to obtain and warns against

'excessive concern for type 1 errors in research in this field'. The authors reiterate the need for the correct evidence type to be applied to the research at hand. Furthermore, as globalisation comprises multiple, interacting policy dynamics, reliance on evidence from multiple disciplines and research methodologies will be required (they identify observational studies as the likely form of evidence to lead policy production). This viewpoint lends itself nicely to the multidisciplinary environment of disaster health practice and is reminiscent of the Bradt's work in this area[137]. The article ends with reference to a statement made by Angus Deaton "economic growth, by itself, will not be enough to improve population health, at least in any acceptable time" This begs the question of what is acceptable time and how should economic growth (and therefore globalisation) be monitored and/or guided to improve population health, particularly given that it has been demonstrated that improved population health will boost economic growth[138]?

Whilst this area of practice is not directly associated with Disaster Health it demonstrates the interconnectedness of programs aimed at Disaster Risk reduction and mitigation, and developmental programs. Furthermore, it could be established that appropriate Disaster Health practice is a determinant of population health, and that once established the Social Determinants of Health (SDH) could act as a framework which Disaster Health practice uses to ensure its actions are appropriate.

Examination of the literature related to disasters and the Social Determinants of Health during the course of this project has identified several gaps in knowledge to inform practice. Themes for consideration include:

- The development of community-based disaster planning entails the strategic development of goals associated with low probability high impact events. Creation and maintenance of engagement, motivation and support and vary of time. If the goals were redefined in terms of community resiliency (i.e., a development model rather than a preparedness model) with improved disaster preparedness as an outcome perhaps engagement could be improved.
- This planning should incorporate indicators relative to the determinants of health (i.e., high school graduation rates, vaccination rates, etc)
- What is good community engagement for such a program and how should it be measured?
- When considering these plans are regional/ remote communities more or less vulnerable compared to urban communities?

These themes informed the following research questions:

2. Is contemporary evaluation of the impacts of Australian Disaster considering the relationship of the Social Determinants of Health of the affected communities?
3. What is the community perception of the relationship of the Social Determinants of Health and disaster resilience?

4. Are the impacts of societal disruption considered with a disaster impact, or disaster risk reduction lens, and if so, what value would this have?

6.2.5 Australian Disaster Inquiries and Reports, a Social Determinants of Health lens

The previous section described proposed several research questions based on the review of literature related to disaster risk and the Social Determinants of Health. This section explores the first research question with an analysis of Australian Disaster inquiry findings and to what extent they informed or considered health determinants of the affected population. Australian disaster inquiries and reports are a feature of disaster preparation, impact and response assessment. The academic literature related to disaster practice has grown substantially and continues to expand. Governments internationally and domestically often conduct inquiries into disaster related events when community expectations have not been met. These inquiries vary in their scope, focus and intent. To identify whether health outcomes are a feature of Australian disaster inquiries an evaluation of Australian disaster inquiries was undertaken to determine what, if any recommendations support action on the causal factors of health and wellbeing as described by WHO using the Social Determinants of Health as a reference standard. The intent was to examine whether the inquiry reports included recommendations undertook action on improving public health and thus improved community resilience and reduced vulnerability.

Disaster inquiries reviewed included:

- Operation Recovery Task Force (Cyclone Larry 2007)
- 2009 Victorian bushfires Royal Commission
- 2010–11 Flood Warnings & Response (Victoria, Australia)
- A Shared Responsibility the Report of the Perth Hills Bushfire February 2011
- 2012 Queensland floods commission of enquiry
- 2013 Tasmanian Bushfires Inquiry
- Hazelwood Mine Fire Inquiry (2014)
- Royal Commission into National Natural Disaster Arrangements (2020)

Operation Recovery Task Force (Cyclone Larry 2007)

Background: Severe Tropical Cyclone Larry made landfall in Australia on 20 March 2006 as a Category 4 with wind gusts reaching 240 kilometres per hour which destroyed over 10,000 homes. Throughout Queensland, Cyclone Larry resulted in roughly 1.5 billion in damage.

Operation Recovery Task Force (Cyclone Larry 2007) terms of reference: No terms of reference were constructed for the review

Table 4: Operation Recovery Task Force (Cyclone Larry 2007) recommendations Social Determinants of Health overarching recommendations comparison

Social Determinants of Health overarching recommendations	Operation Recovery Task Force (Cyclone Larry 2007) recommendations
Improve Daily Living Conditions	0 recommendations
Tackle the Inequitable Distribution of Power, Money, and Resources	5 recommendations
Measure and Understand the Problem and Assess the impact of Action	1 recommendation

Operation Recovery Task Force (Cyclone Larry 2007) key findings that align with Social Determinants of Health overarching recommendations included:

- Enable civil society to organize and act in a manner that promotes and realizes the political and social rights affecting health equity.
- A concerted effort should be made to engage NGOs and volunteer groups in contingency planning and preparations for natural disasters.

2009 Victorian bushfires Royal Commission

Background: The Black Saturday bushfires were a series of bushfires that ignited or were burning across the Australian state of Victoria on and around Saturday, 7 February 2009 and are Australia's worst bushfire disaster. The fires occurred during extreme bushfire-weather conditions and resulted in 173 deaths, 3,500 buildings destroyed (2,029 houses), and an estimated cost of 4.4 billion Australian dollars.

2009 Victorian bushfires Royal Commission terms of reference

- The causes and circumstances of the bushfires which burned in various parts of Victoria in late January and February 2009
- The preparation and planning by governments, emergency services, other entities, the community and households for bushfires in Victoria, including current laws, policies, practices, resources and strategies for the prevention, identification, evaluation, management and communication of bushfire threats and risks.
- All aspects of the response to the 2009 bushfires, particularly measures taken to control the spread of the fires and measures taken to protect life and private and public property, including but not limited to:
 1. Immediate management, response and recovery
 2. Resourcing, overall coordination and deployment; and

3. Equipment and communication systems

- The measures taken to prevent or minimise disruption to the supply of essential services such as power and water during the 2009 bushfires.
- Any other matters that you deem appropriate in relation to the 2009 bushfires

Table 5: 2009 Victorian bushfires Royal Commission recommendations and Social Determinants of Health overarching recommendations comparison

Social Determinants of Health overarching recommendations	2009 Victorian bushfires Royal Commission recommendations
Improve Daily Living Conditions	4 recommendations
Tackle the Inequitable Distribution of Power, Money, and Resources	2 recommendations
Measure and Understand the Problem and Assess the impact of Action	1 recommendation

2009 Victorian bushfires Royal Commission key findings that align with Social Determinants of Health overarching recommendations included:

- The breadth of scope of the Royal Commission resulted in recommendations that, in addition to previous reports focussed on research and social inclusion
- The Commonwealth establish a national centre for bushfire research in collaboration with other Australian jurisdictions to support pure, applied and long-term research in the physical, biological and social sciences relevant to bushfires and to promote continuing research and scholarship in related disciplines.

Review of the 2010–11 Flood Warnings & Response (Victoria, Australia)

Background: Rainfall in January 2011 caused major flooding across western and central Victoria. Further rainfall events caused repeated flash flooding in affected areas in early February in many of the communities affected by January's floods. Outcomes included 51 communities were affected by the floods. Over 1,730 properties were flooded. Over 17,000 homes lost their electricity supply. The Department of Primary Industries later calculated a damage bill of up to 2 billion Australian dollars.

2010–11 Flood Warnings & Response (Victoria, Australia) Terms of reference:

- The adequacy of flood predictions, including technology and modelling techniques used.

- The adequacy, timeliness and effectiveness of flood warnings and public information.
- Emergency services command and control arrangements utilised to manage the emergency.
- The adequacy of evacuations of people at greatest risk including health and aged care facilities.
- The adequacy of clean-up and recovery arrangements.
- The adequacy of service delivery by state and federal government agencies, local governments and volunteer-based organisations.
- The adequacy of the funding provided by the state and federal governments in the form of emergency grants in their various categories.
- This review will seek advice from experts in the field of flood management and will involve extensive community consultation, especially with regard to emergency warnings and evacuations.

Table 6: 2010–11 Flood Warnings & Response (Victoria, Australia) recommendations and Social Determinants of Health overarching recommendations comparison

Social Determinants of Health overarching recommendations	Review of the 2010–11 Flood Warnings & Response recommendations
Improve Daily Living Conditions	17 recommendations
Tackle the Inequitable Distribution of Power, Money, and Resources	10 recommendations
Measure and Understand the Problem and Assess the impact of Action	0 recommendations

Review of the 2010–11 Flood Warnings & Response (Victoria, Australia) key findings aligning with Social Determinants of Health overarching recommendations included:

- requiring that local knowledge is considered as a critical component of all phases of emergency management
- involving local communities in the development and ownership of community resilience plans based on an ‘all hazards’ approach and tailored for the specific needs of each community
- encouraging local communities to form resilience committees to develop and administer community resilience plans
- nominating Victoria Police as the lead agency in initiating the strategy to develop community resilience committees; and
- requiring emergency service agencies to consult and engage with local community resilience committees in the preparation, planning, response and recovery phases of emergency management.

- The Departments of Health and Human Services finalise the definition of ‘vulnerable person’ and the list of facility types where vulnerable people are located and ensure that the definition and associated policies are applicable across ‘all hazards.

A Shared Responsibility the Report of the Perth Hills Bushfire February 2011 Review

Background: On the weekend of 5 and 6 February 2011, two major bushfires devastated separate areas of the natural and built environments in the Perth metropolitan area. Wind gusts up to 75 kilometres an hour spread the fires quickly. The fire destroyed 72 homes and damaged 37 others. No lives were lost

A Shared Responsibility the Report of the Perth Hills Bushfire February 2011 Review terms of reference:

- The adequacy of current preventative measures specifically prescribed burning and other bushfire mitigation activities.
- The impact of land use, environmental and building laws, practices and policies in the affected areas, affecting bushfire prevention, mitigation and response and what, if any, changes may be required.
- The actions that can and should be taken by landowners, residents and tenants in relation to bushfire risk management including undertaking vegetation clearance, operation of evaporative air-conditioners and storage and/or removal of hazardous inflammable material surrounding their dwellings and buildings. This should include consideration of associated enforcement regimes and penalties.
- The adequacy and effectiveness of information and communication campaigns and mechanisms, including systems for alerting residents in relation to the fire or potential fires.
- Improvements that can be made in relation to the coordination of activities across all levels of government, including with volunteer groups.

Table 7: A Shared Responsibility the Report of the Perth Hills Bushfire February 2011 Review recommendations and Social Determinants of Health overarching recommendations comparison

Social Determinants of Health overarching recommendations	A Shared Responsibility the Report of the Perth Hills Bushfire February 2011 Review recommendations
Improve Daily Living Conditions	4 recommendations
Tackle the Inequitable Distribution of Power, Money, and Resources	8 recommendations
Measure and Understand the Problem and Assess the impact of Action	0 recommendations

A Shared Responsibility the Report of the Perth Hills Bushfire February 2011 Review key findings that align with Social Determinants of Health overarching recommendations included:

- The bushfire report featured a focus on urban planning and community engagement in risk understanding. The Perth Hills report also featured recommendations to improve early life education and increased understanding of the effects of climate change

2012 Queensland floods commission of enquiry

Background: A series of floods forced the evacuation of thousands of people from towns and cities in Queensland, affecting over 200,000 people, 38 of which lost their lives. Damage has been estimated at \$2.38 billion Australian dollars. Three-quarters of the council areas within the state of Queensland were declared disaster zones.

2012 Queensland floods commission of enquiry terms of reference:

- the preparation and planning by federal, state and local governments; emergency services and the community for the 2010/2011 floods in Queensland,
- the performance of private insurers in meeting their claims responsibilities,
- all aspects of the response to the 2010/2011 flood events, particularly measures taken to inform the community and measures to protect life and private and public property, including immediate management, response and recovery resourcing, overall coordination and deployment of personnel and equipment adequacy of equipment and communications systems: and the adequacy of the community's response.
- the measures to manage the supply of essential services such as power, water and communications during the 2010/2011 flood events,
- adequacy of forecasts and early warning systems particularly as they related to the flooding events in Toowoomba, and the Lockyer and Brisbane Valleys,
- implementation of the systems operation plans for dams across the state and in particular the Wivenhoe and Somerset release strategy and an assessment of compliance with, and the suitability of the operational procedures relating to flood mitigation and dam safety,
- all aspects of land use planning through local and regional planning systems to minimise infrastructure and property impacts from floods, in undertaking its inquiries, the Commission is required to:
 - take into account the regional and geographic differences across affected communities; and
 - seek public submissions and hold public hearings in affected communities.

Table 8: 2012 Queensland floods commission of enquiry recommendations and Social Determinants of Health overarching recommendations comparison

Social Determinants of Health overarching recommendations	2012 Queensland floods commission of enquiry recommendations

Improve Daily Living Conditions	2 recommendations
Tackle the Inequitable Distribution of Power, Money, and Resources	10 recommendations
Measure and Understand the Problem and Assess the impact of Action	1 recommendation

2012 Queensland floods commission of enquiry key findings that align with Social Determinants of Health overarching recommendations included:

- Recommendations demonstrated a focus on urban planning in respect to flood plain management
- Engagement in local communities in managing risk featured within recommendations

2013 Tasmanian Bushfires Inquiry

Background: In January 2013, the heat wave known as the ‘Angry Summer’ affecting the greater portion of the south and east of Australia resulted in multiple fires in Tasmania causing 1 death, 89 million dollars in insurance costs, and destroyed 203 homes.

2013 Tasmanian Bushfires Inquiry terms of reference

- The immediate causes and circumstances of the bushfires which were active in Tasmania on the 4 January 2013, with particular focus on the three bushfires that caused the most significant property loss: the “Forcett Fire”, “Lake Repulse Fire” and the “Bicheno Fire”.
- All aspects of the emergency response on the 4 January 2013, particularly measures taken to control the spread of the three main fires and to protect life, private and public property and essential infrastructure.
- The adequacy of the transition from response to recovery in the week following the 4 January 2013.
- The preparation and planning by all levels of government, agencies and the emergency services for the fire season of 2012/13 in general and the catastrophic fire danger weather event on 4 January 2013 in particular
- The effectiveness of the strategies and plans related to managing bushfire risk in Tasmania that were in place prior to the bushfires burning on 4 January 2013.
- The use and efficacy of community alerts, warnings and information arrangements in general and in particular the use and efficacy of various forms of social media by
 - a. authorities in responding to bushfires; and
 - b. private citizens, during bushfires; and
 - c. the adequacy of existing arrangements for dealing with that use in a constructive and safe manner.
- Any other matters relevant to the terms of reference

Table 9: 2013 Tasmanian Bushfires Inquiry recommendations and Social Determinants of Health overarching recommendations comparison

Social Determinants of Health overarching recommendations	2013 Tasmanian Bushfires Inquiry recommendations
Improve Daily Living Conditions	7 recommendations
Tackle the Inequitable Distribution of Power, Money, and Resources	12 recommendations
Measure and Understand the Problem and Assess the impact of Action	2 recommendations

2013 Tasmanian Bushfires Inquiry key findings that align with Social Determinants of Health overarching recommendations included:

- Urban planning and societal inclusion in relation to understanding disaster risk also featured in recommendations
- That the Government take into account demographic change in its assessment of the consequences of climate change on emergency events.

Hazelwood Mine Fire Inquiry (2014)

Background: The Hazelwood Coal Mine Fire, started at the mine on 9 February 2014 and was described as "one of the largest, longest running and most complex fires in the State's history". Thousands of people were affected by smoke and ash from the fire. The Hazelwood Mine Fire Inquiry Report was published in 2016 and stated that the community has experienced adverse health effects and may be affected for an indeterminate period into the future. The inquiry found that 11 premature deaths were attributed to the mine fire

Hazelwood Mine Fire Inquiry (2014) terms of reference

- The Board was asked to inquire into the circumstances of the mine fire, the emergency response and the support provided to affected communities. The Board heard of the experiences of people affected by the mine fire in its community consultations, in written submissions and at public hearings held in Morwell. It independently reviewed the actions of State departments and agencies, local government and GDF Suez. It also engaged its own experts in the areas of health, mine safety, fire risk management, air pollution and communications. A 400-page plus report (including an executive summary and recommendations) has been written in response to the Board's Terms of Reference and the information it received. The report answers important questions raised by the people of Morwell and the Latrobe Valley including:
 - What are the potential health implications now and into the future?

- What fire prevention measures were put in place by GDF Suez?
- Who is responsible for regulating the mine?
- How did the mine fire start?
- What can be done to prevent incidents like this from happening again?

Table 10: Hazelwood Mine Fire Inquiry (2014) recommendations and Social Determinants of Health overarching recommendations comparison

Social Determinants of Health overarching recommendations	Hazelwood Mine Fire Inquiry (2014) recommendations
Improve Daily Living Conditions	9 recommendations
Tackle the Inequitable Distribution of Power, Money, and Resources	10 recommendations
Measure and Understand the Problem and Assess the impact of Action	2 recommendations

Hazelwood Mine Fire Inquiry (2014) key findings that align with Social Determinants of Health overarching recommendations included:

- That the State develop and widely disseminate an integrated State Smoke Guide, to incorporate the proposed State Smoke Plan for the management of public health impacts from large scale, extended smoke events; include updated Bushfire Smoke, carbon monoxide and PM2.5 protocols; and provide practical advice and support materials to employers, communities and individuals on how to minimise the harmful effects of smoke
- The State should continue the long-term health study, and:
 - a. extend the study to at least 20 years.
 - b. appoint an independent board, which includes Latrobe Valley community representatives, to govern the study; and
 - c. direct that the independent board publish regular progress reports.

Royal Commission into National Natural Disaster Arrangements (2020)

Background: The Royal Commission into National Natural Disaster Arrangements was established on 20 February 2020 in response to the extreme bushfire season of 2019-20 which resulted in loss of life, property and wildlife and environmental destruction. The Commission examined coordination, preparedness for, response to and recovery from disasters as well as improving resilience and adapting to changing climatic conditions and mitigating the impact of natural disasters. The inquiry also considered the legal framework for Commonwealth involvement in responding to national emergencies.

Royal Commission into National Natural Disaster Arrangements (2020) terms of reference:

- a. the responsibilities of, and coordination between, the Commonwealth and State, Territory and local Governments relating to preparedness for, response to, resilience to, and recovery from, natural disasters, and what should be done to improve these arrangements, including with respect to resource sharing.
- b. Australia's arrangements for improving resilience and adapting to changing climatic conditions, what actions should be taken to mitigate the impacts of natural disasters, and whether accountability for natural disaster risk management, preparedness, resilience and recovery should be enhanced, including through a nationally consistent accountability and reporting framework and national standards.
- c. whether changes are needed to Australia's legal framework for the involvement of the Commonwealth in responding to national emergencies, including in relation to the following:
 - thresholds for, and any obstacles to, State or Territory requests for Commonwealth assistance.
 - whether the Commonwealth Government should have the power to declare a state of national emergency.
 - how any such national declaration would interact with State and Territory emergency management frameworks.
 - whether, in the circumstances of such a national declaration, the Commonwealth Government should have clearer authority to take action (including, but without limitation, through the deployment of the Australian Defence Force) in the national interest.
- d. any relevant matter reasonably incidental to a matter referred to in paragraphs (a) to (c).
- e. ways in which Australia could achieve greater national coordination and accountability — through common national standards, rulemaking, reporting and data-sharing — with respect to key preparedness and resilience responsibilities, including for the following:
 - land management, including hazard reduction measures.
 - wildlife management and species conservation, including biodiversity, habitat protection and restoration.
 - land-use planning, zoning and development approval (including building standards), urban safety, construction of public infrastructure, and the incorporation of natural disaster considerations.
 - any ways in which the traditional land and fire management practices of Indigenous Australians could improve Australia's resilience to natural disasters.

Table 11: Royal Commission into National Natural Disaster Arrangements (2020) recommendations and Social Determinants of Health overarching recommendations comparison

Social Determinants of Health overarching recommendations	Royal Commission into National Natural Disaster Arrangements (2020) recommendations
Improve Daily Living Conditions	5 recommendations
Tackle the Inequitable Distribution of Power, Money, and Resources	2 recommendations
Measure and Understand the Problem and Assess the impact of Action	6 recommendations

Royal Commission into National Natural Disaster Arrangements (2020) key findings that align with Social Determinants of Health overarching recommendations included:

- State and territory governments should continue to deliver, evaluate and improve education and engagement programs aimed at promoting disaster resilience for individuals and communities.
- State and territory governments should ensure those responsible for evacuation planning periodically review these plans, and update them where appropriate, to account for the existence and standard of any evacuation centres and safer places (however described) in the community, including:
 - a. the capacity of a centre to handle seasonal population variation
 - b. the suitability of facilities to cater for diverse groups, including vulnerable people, and those evacuating with animals, and
 - c. the existence of communications facilities and alternate power sources.
- Australian, state and territory governments should:
 - a. develop close to real-time, nationally consistent air quality information, including consistent categorisation and public health advice
 - b. greater community education and guidance, and
 - c. targeted health advice to vulnerable groups.
- Australian, state and territory governments should develop national air quality forecasting capabilities, which include broad coverage of population centres and apply to smoke and other airborne pollutants, such as dust and pollen, to predict plume behaviour.
- Australian, state and territory governments should refine arrangements to support localised planning and the delivery of appropriate mental health services following a natural disaster.
- Australian, state and territory governments should agree to:
 - a. develop consistent and compatible methods and metrics to measure health impacts related to natural disasters, including mental health, and
 - b. take steps to ensure the appropriate sharing of health and mental health datasets.
- State and territory governments should:

- a. each have a process or mechanism in place to communicate natural hazard risk information to households (including prospective purchasers) in 'hazard prone' areas, and
 - b. work together, and with the Australian Government where appropriate, to explore the development of a national mechanism to do the same.
- State, territory and local governments should be required to consider present and future natural disaster risk when making land-use planning decisions for new developments.
- Australian, state and territory governments should expedite the development of pre agreed recovery programs, including those that address social needs, such as legal assistance domestic violence, and also environmental recovery.

Table 12. Summary report of inquiry recommendations that aligned with the Social Determinants of Health overarching recommendations

Social Determinants of Health overarching recommendations	2010–11 Victorian Flood Warnings & Response (93 recommendations)	2014 Hazelwood Mine Fire Inquiry (18 recommendations)	2012 Queensland floods commission of enquiry (189 recommendations)	2009 Victorian bushfires Royal Commission (67 recommendations)	Operation Recovery Task Force (Cyclone Larry 2007) (7 recommendations)	2013 Tasmanian Bushfires Inquiry (103 recommendations)	A Shared Responsibility the Report of the Perth Hills Bushfire February 2011 (55 recommendations)	Royal Commission into National Natural Disaster Arrangements (2020) (80 recommendations)
Improve Daily Living Conditions	17	9	2	4		7	4	5
Tackle the Inequitable Distribution of Power, Money, and Resources	10	10	10	2	5	12	8	2
Measure and Understand the Problem and Assess the impact of Action		2	1	1	1	2		6

Key Findings

Of the eight (8) reports reviewed the focus of the inquiries differed. Whilst the terms of reference varied, themes included: prevention, preparedness, response and recovery practice, event causal factors, insurance arrangements, risk assessment, public warning, immediate and future potential health implications. Key findings noted from the review included

- Inconsistency of investigators and investigation process across inquiries
- No clear framework for consistent evaluation of an event when an inquiry was called
- Recommendations focussed primarily on emergency management structure and practice, with low engagement in health, health equity, and/or health protection as drivers or outputs.
- A finding of higher correlation across inquiries of recommendations associated with overarching Social Determinants of Health recommendation 'Tackle the Inequitable Distribution of Power, Money, and Resources'. This appeared to be due to recommendations associated with communication between state and communities, engaging communities in disaster risk, identifying state and government roles and functions in recommendations.
- Inconsistent identification of health impacts and recommendations related to health status across inquiries, with some inquiry findings recognising need to address health outside of the traditional Prevention, Preparedness, Response, Recovery model
- Although the scope of terms of reference of the reports were broad enough to be inclusive of risk, risk factors and resilience, the recommendations focussed primarily on emergency management structure and practice, and demonstrated lower engagement in health, health equity, and/or health protection as drivers or outputs.

These findings were used to inform the methodology of the next study which explored community perception of the Social Determinants of Health relationship to disaster risk reduction and resilience.

6.2.6 Study 2 Methodology

Mixed methods were used in Study 2. A theme list inspired by the previous chapter findings and health elements following guiding principles of the Social Determinants of Health was developed [118]. This was informed by the literature review of how causal factors of population health relate to, and impact upon disaster risk, resilience, vulnerability, impact and recovery. Qualitative data was collected through key informant semi-structured interviews utilising the developed them list.

This research seeks to address the knowledge gap in how communities relate disaster risk reduction to their health status and to what extent they perceive drivers of health status as important to being disaster resilient. As a case study to answer these research questions, we investigated in Dwellingup, a small town in Western Australia. Dwellingup is a town located in a timber and agricultural area of the Darling Range in Western Australia 97 km south of Perth. The town's location is in a heavily wooded region with hilly terrain results in a hazard of bushfire. A bushfire in 1961 resulted in vast destruction of land and homes in Dwellingup and the surrounding community. 132 houses were destroyed and 800 people were left homeless [85]. Dwellingup suffered bushfire again in 2007 resulting in widespread property and forest destruction, 16 houses were destroyed.

Using purposive sampling thirty-three face-to-face interviews were requested of the local community via a local emergency management member. Of these, eighteen accepted to be interviewed while the remaining fifteen did not respond to the email request. No potential interviewees refused to participate once they accepted. Participants were selected using purposive sampling in the sense that were chosen based on experience as a community member in connection to local disaster risk management. This community was accessible during the COVID-19 Pandemic and enabled continuation of the research during National and International restricted movement and impact. Participant demographics are presented in Box 1. Data collection was conducted between March 2018 and May 2019, and a typical interview lasted between 45 – 60 minutes. No further participant interviews were sought following the eighteenth participant as responses indicated no new information was obtained. Coding for the interview questions and thematic analysis relative to research questions was conducted using narrative inquiry according to the six step process described by Braun and Clarke [71]. Quantitative data describing the community was collected from the Australian Bureau of Statistics [139].

Ethical Considerations

All respondents provided written informed consent prior to participation, provided by scanned version or picture by e-mail, and did not receive any incentives to participate in the study. Ethical approval was requested and obtained from Monash University Human Research Ethics Committee (HREC 7539). Recordings were stored safely and kept confidential as per The Australian Code for the Responsible Conduct of Research, and the Monash University HREC Guidelines.

6.2.7 Results

Thematic analysis of the qualitative data was conducted in 6 phases, consistent with the methodology described by Braun et al [71]. Phase one involved data familiarisation and review of respondent and community demographics (box 1, tables 14, 15). Generation of initial transcript codes (boxes 2, 3, 4, 5) was conducted in phase two, from which initial themes were developed and described in phases three and four. The themes were defined and named in phase 5 (table 16).

Phase One

Box 1: Sample demographics
Participant Gender: <ul style="list-style-type: none"> • Male: 11 • Female: 7
Relationship status: <ul style="list-style-type: none"> • Single: 4 • Partner: 14
Age: <ul style="list-style-type: none"> • (below 20): 0 • (21-30): 1 • (41-50): 6 • (51-60): 2 • (above 60): 9

The latest census in 2016 recorded a population of 557 in Dwellingup with the following demographics [140](table 13).

Table 13 Dwellingup 2016 Census demographics [140]

Demography	Outcome
Population	557
Male	51.8%
Female	48.2%
Median age	46
Families	145
All private dwellings	308
Average people per household	2.4

The sample population interviewed for this study was representative of the community population.

The Socio-Economic Indexes for Areas (SEIFA) for Dwellingup was accessed via the Australian Bureau for Statistics (ABS) census data to determine the relative advantage and disadvantage of the area compared to the rest of Australia. A SEIFA score is an average of people and households within a given area using a set of four indexes which provide summary measures derived from the ABS census to understand the relative level of social and economic wellbeing of a region. The definition applied by SEIFA of relative

socio-economic disadvantage relates to access of material and social resources, and the ability to participate in society based on characteristics of people, families and dwellings within that area. SEIFA measures have been reported as deciles where the lowest scoring 10% of areas are given a decile number of 1, up to the highest 10% of areas which are given a decile number of 10. The four (4) SEIFA indices are the Index of Relative Socio-Economic Disadvantage (IRSD), the Index of Relative Socio-Economic Advantage and Disadvantage (IRSAD), the Index of Economic Resources (IER), and the Index of Education and Occupation (IEO) [139].

The IRSAD summarises economic and social conditions of people and households within an area. The index includes measures of relative advantage and disadvantage; therefore, a high score (or decile) reflects a relative advantage and lack of disadvantage. The IRSD includes only measures of relative disadvantage, therefore a high score (or decile) reflects a relative lack of disadvantage. The IER summarises fifteen (15) variables related to income and wealth providing an index of financial aspects of relative socio-economic advantage and disadvantage. This index includes measures that capture both 'low' and 'high' access to economic resources. The IEO is designed to reflect the educational and occupational skill level of communities. The nine (9) measures used in this index include qualifications achieved, further education undertaken, occupations that require a high and low level of skills, and unemployment. The index does not include income levels [139].

The SEIFA scores of the region (Murray) that Dwellingup resides in describe how both Dwellingup and the surrounding area compare relative to Australia. Table 14 shows the Murray SEIFA scores and demonstrates that the area is above average in respect to socio economic advantage and economic resources (IRSAD, IRSD, IER) and slightly below average in respect to education and occupation (IEO) compared to other Australian regions.

Table 14: SEIFA scores, Murray Western Australia - Wheat Belt [139]

Socio-Economic Indexes for Areas (SEIFA)	Score	Decile
Index of Relative Socio-Economic Advantage and Disadvantage (IRSAD)	1010	6
Index of Relative Socio-Economic Disadvantage (IRSD)	1013	6
Index of Economic Resources (IER)	1049	8
Index of Education and Occupation (IEO)	943	4

Phase Two

Box 2: Coded transcript

Transcript	Codes
<ul style="list-style-type: none"> • <i>Suffering previous, similar disasters develops experience and knowledge</i> • <i>The size of a community result in different meanings as to what a disaster really is. Small communities are more resilient because they feel they are on their own, therefore they won't wait for help because they don't think it will come.</i> • <i>Having close community networks can be positive and negative – if you're in you're in</i> • <i>Sometimes it's up to the person to seek their needs and understand the local context. In a small community with risks, you have to take responsibility for yourself, if you don't, you're more vulnerable</i> 	<p>Previous exposure was connected to increased preparedness (experience and knowledge were enhancers of preparedness)</p> <p>Preparedness at an individual level and connection with local community featured as attributes of resilience.</p> <p>The local community was viewed as a source of knowledge and support that was accessible if an individual was connected to it.</p> <p>An individual may reside in the community however this did not imply that they were connected to it. Community size seems to contribute to a sense of autonomy and proactive behaviour. Two respondents mentioned this connection between size and this behaviour</p>
<ul style="list-style-type: none"> • <i>Holiday homeowners and tourists are less aware of what to do and the local community structure. Plans need to account for these</i> • <i>Tourists lack understanding and knowledge of local risk and are therefore less able to risk assess</i> • <i>'Weekenders' (holiday homeowners) are not engaged with the local community.</i> • <i>Not being a part of the community network increases risk. There are loners that live here that aren't connected within the community.</i> 	<p>Specific groups of holidays homeowners, loners within the community, new community residents and tourists were considered at risk/vulnerable due to their perceived lack of local knowledge of the environment, the risk it posed and required preparedness to mitigate it, and lack of community connection.</p>
<ul style="list-style-type: none"> • <i>Being able to respond, mentally strong</i> • <i>Being healthy is important as it means you have capacity to respond to a threat.</i> 	<p>Having good physical and mental health was considered important in being able to respond to disaster and be resilient to the impact of disaster.</p>

<ul style="list-style-type: none"> • <i>Health is having physical and mental capabilities to be able to do what you want and participate with the community</i> • <i>Poor health reduces your ability to respond and cope with a disaster.</i> • <i>Being healthy is important as because from start to finish disasters affect your resilience. If you're fit and healthy (mind and body) you have greater ability to respond, recover and lift yourself up. It's going to be very important.</i> • <i>Physically fit, mentally fit</i> • <i>Being able to respond effectively and independently</i> 	<p>Good health was described as being able to self-care and having physical and mental fitness. (Q6, Q7, Q8, Q11)</p>
<ul style="list-style-type: none"> • <i>Elderly and very young are dependent on family (Q2, Q 11)</i> • <i>Elderly isn't able enough and are set in their ways therefore less engaged in the community</i> • <i>Elderly – physical capacity to respond to an event.</i> 	<p>Elderly populations were perceived as being vulnerable to disasters.</p> <p>The elderly was considered more vulnerable due to constrained physical capacity and family dependency.</p>
<ul style="list-style-type: none"> • <i>Communication with each other and knowing where to go to get information</i> • <i>Knowing what the risks are, where you would find information and redundancy in communication of this. Having a community meeting point</i> • <i>Good communication, being aware of the actual risk</i> 	<p>Having good communication and risk awareness was a common priority of respondents for disaster response and preparedness</p>
<ul style="list-style-type: none"> • <i>To make it safe requires a community effort not just one person, everyone has to pull together</i> • <i>Having community and personal plans in place, key people with key roles. Plans for how we manage short term post event and guides for agency engagement post event.</i> 	<p>Disaster plans for communities need consultation, training, testing, role assignment, community participation with agencies and support.</p>

<ul style="list-style-type: none"> • <i>Evacuate vulnerable early and engage in support activities that support front line staff.</i> 	
--	--

Vulnerability Profile

Participants were asked to grade on a scale of 1 to 10 (1: very low, 10: very high) how vulnerable the following groups are. Scores were tallied to produce mean results:

Box 3 (question 4)

Variable	Mean
Men	5.8
Women	5.3
Children (age <14yo)	8.1
Elderly	8.8
Disabled	8.8
Unemployed	4.2
Homeless	6.2
Poverty	5.0
Indigenous	4.8
Non-English speaking	5.0
Local	3.8
Visitors	8.5

Participants were asked to grade on a scale of 1 to 10 (1: very low, 10: very high), how important is health in reference to disaster resilience:

Box 4 (question 7)

Category	Mean
On a scale of 1 to 10 (1: very low, 10: very high), how important is health in reference to disaster resilience:	8.5

Participants were asked to grade on a scale of 1 to 10, rate whether the following traits (based on the WHO definition of Social Determinants of Health) impact on an individual's disaster resilience (1: very low impact, 10: very high impact):

Box 5 (question 11)

Category	Mean
Social gradient (where an individual is on the social ladder in each society)	6.3
Stress (where an individual is experiencing long term stress)	7.8
Early life experience (where an individual experiences early life development and education)	7.7
Social exclusion (where an individual experiences poverty, social exclusion, discrimination)	8.6
Work (where an individual experiences workplace stress and low control over their work)	5.1
Unemployment (where an individual has low job security or unemployment)	4.5
Social support (where an individual has friendships, good social relationships and strong social networks)	6.2
Addiction (where an individual has alcohol, drug or cigarette dependence)	6.7
Food (where an individual has a good diet and adequate food supply)	5.2
Transport (where an individual uses healthy transport options and has access to public transport)	6.7
Religion (where an individual is actively participating in faith-based activities)	1.5
Chronic disease (where an individual has chronic health issues)	7.2
Insurance (where an individual has adequate insurance – health, personal, property)	8.0
Mental Health (where an individual has good mental health)	8.6
Governance (where there is accountability/transparency in public administration)	6.5

Phase Three

The following generated codes were assessed for theme generation:

- Preparedness at an individual level and connection with local community featured as attributes of resilience. The local community was viewed as a source of knowledge and support that was accessible if an individual was connected to it. An individual may reside in the community however this did not imply that they were connected to it.
- Specific groups of holiday homeowners, loners within the community, new community residents and tourists were considered at risk/vulnerable due to their perceived lack of local knowledge of the environment, the risk it posed, required preparedness to mitigate it, and lack of community connection.
- Having good physical and mental health was considered important to being disaster resilient (Box 4).
- Good health was described as being able to self-care and having physical and mental fitness.
- Religion (where an individual is actively participating in faith-based activities) was not perceived as being an important trait for disaster resilience (Box 5).
- Stress (where an individual is experiencing long term stress) and mental health (where an individual has good mental health) were perceived as having significant impact on an individual's disaster resilience (Box 5).
- Elderly and disabled populations were perceived as being vulnerable to disasters (Box 3).
- The elderly was considered more vulnerable due to perceived physical frailty, reduced access to transportation, decreased community participation and family reliance/dependency.
- Local residents and unemployed were perceived as being least vulnerable (Box 3).
- Having good communication was a common priority of respondents for disaster response and preparedness.
- Disaster plans for communities need training, testing, consultation and community participation.

Phase 4: Reviewing potential themes.

Using the Braun and Clark methodology where a theme “captures something important about the data in relation to the research question, and represents some level of patterned response or meaning within the data set” [71], the codes were reviewed to identify similarity or overlap and whether unification of codes into central themes or sub themes was appropriate. Exploration of health within interviewee responses demonstrated a pattern where strong physical and mental health were considered important traits of disaster resilience; codes 3, 4 and 6 were collapsed to a theme of health and disaster resilience. Many responses clustered around the importance of community connection and participation as a determinant of disaster resilience through the mutual exchange of knowledge and support, as such code 1 was developed as a singular theme. Codes 2 and 6 were collapsed into a theme of vulnerability related to social exclusion. A singular theme of disaster socio demographic vulnerability was created based on codes 7, 8 and 9.

Communication, local education, community consultation, participation and testing of plans were identified as traits that disaster management plans should provide, describe or plan for and formed a theme. The final five themes developed were:

- 7 Community connection and participation provides a source of knowledge and support that enhances risk awareness and preparedness that improves an individual's disaster resilience.
- 8 Stress (where an individual is experiencing long term stress) and social exclusion and/or lack of connection within a local community increases an individual's vulnerability to disaster.
- 9 Perceptions of disaster vulnerability varies between community demographic groups.
- 10 Disaster resilience is a function of good physical and mental health.
- 11 Effective disaster planning requires community partnership in the development, education and testing. Robust communication is an essential trait of communication plans.

The five developed themes with illustrated quotes are shown in Phase 5 table 15.

Phase 5: Defining and naming themes

Table 15: Five themes developed from seven codes with illustrative data extracts (direct quotes)

Local knowledge, sense of community and participation are enhancers of disaster resilience.	Long lasting stress and social exclusion and/or lack of connection within a local community increases an individual's vulnerability to disaster.	Perceptions of disaster vulnerability varies between community demographic groups.	Disaster resilience is a function of good physical and mental health.	Effective disaster planning requires community partnership in the development, education and testing. Robust communication is an essential trait of communication plans.
<p><i>Suffering previous, similar disasters develops experience and knowledge</i></p> <p><i>The size of a community result in different meanings as to what a disaster really is. Small communities are more resilient because they feel they are on their own, therefore they won't wait for help</i></p>	<p><i>Holiday homeowners and tourists are less aware of what to do and the local community structure. Plans need to account for these</i></p> <p><i>Tourists lack understanding and knowledge of local risk and are therefore less able to risk assess</i></p> <p><i>'Weekenders' (holiday homeowners) are not</i></p>	<p><i>The elderly and very young are dependent on family</i></p> <p><i>The elderly isn't able enough and are set in their ways therefore less engaged in the community</i></p> <p><i>Elderly – physical capacity to respond to an event.</i></p> <p><i>Religion (where an individual is actively participating in faith-</i></p>	<p><i>Being able to respond, mentally strong</i></p> <p><i>Being healthy is important as it means you have capacity to respond to a threat.</i></p> <p><i>Health is having physical and mental capabilities to be able to do what you want and participate with the community</i></p>	<p><i>Communication with each other and knowing where to go to get information</i></p> <p><i>Knowing what the risks are, where you would find information and redundancy in communication of this. Having a community meeting point</i></p> <p><i>Good communication, being aware of the actual risk</i></p> <p><i>To make it safe requires a community effort not just one</i></p>

<p><i>because they don't think it will come.</i></p> <p><i>Having close community networks can be positive and negative – if you're in you're in</i></p> <p><i>Sometimes it's up to the person to seek their needs and understand the local context. In a small community with risks, you have to take responsibility for yourself, if you don't, you're more vulnerable</i></p>	<p><i>engaged with the local community.</i></p> <p><i>Not being a part of the community network increases risk. There are loners that live here that aren't connected within the community.</i></p>	<p><i>based activities) was not perceived as being an important trait for disaster resilience (Box 5)</i></p> <p><i>Social exclusion (where an individual experiences poverty, social exclusion, discrimination) and mental health (where an individual has good mental health) were perceived as having significant impact on an individual's disaster resilience (Box 5).</i></p> <p><i>Elderly and disabled populations were perceived as being vulnerable to disasters (Box 3).</i></p> <p><i>Local residents and unemployed were perceived as being</i></p>	<p><i>Poor health reduces your ability to respond and cope with a disaster.</i></p> <p><i>Being healthy is important as because from start to finish disasters affect your resilience. If you're fit and healthy (mind and body) you have greater ability to respond, recover and lift yourself up. It's going to be very important.</i></p> <p><i>Physically fit, mentally fit</i></p> <p><i>Being able to respond effectively and independently</i></p>	<p><i>person, everyone has to pull together</i></p> <p><i>Having community and personal plans in place, key people with key roles. Plans for how we manage short term post event and guides for agency engagement post event.</i></p> <p><i>Evacuate vulnerable early and engage in support activities that support front line staff.</i></p>
--	---	--	---	---

		<i>least vulnerable (Box 3).</i>		
--	--	----------------------------------	--	--

6.2.8 Discussion

Local knowledge, sense of community and participation are enhancers of disaster resilience.

Interviewees demonstrated strong beliefs in respect to local knowledge and community connection as factors that influenced disaster resilience. When describing elements of a disaster resilient community, respondents identified that strong networks within the local community contributed to improved disaster resilience. Underpinning these community relationships was a sense of common bonding and care between community members. Examples provided by interviewees included:

‘Common identity (sense of belonging), concern for fellow humans at an individual level. Having a lack of selfishness in respect to helping the community and having investment in the future of the community’

‘Having local knowledge, knowing the history of the place’

‘Knowing neighbours (I didn’t know my neighbours in the suburbs), there’s more community connection in the country’

‘Having a sense of community, without that people don’t want to help each other, just themselves’

Moreover, when this theme was explored further respondents demonstrated strong feelings of independence and self-reliance as a community.

‘The size of a community (sic) result in different meanings as to what a disaster really is. Small communities are more resilient because they feel they are on their own, therefore they won’t wait for help because they don’t think it will come.’

The local community was viewed as a source of knowledge and support that was accessible if an individual was connected to it, however it was noted that whilst an individual may reside in the community this did not imply that they were connected to it. This finding was explored further in theme 3.

Long lasting stress and social exclusion and/or lack of connection within a local community increases an individual’s vulnerability to disaster.

Stress and social exclusion were perceived by many to have a significant impact on an individual’s disaster resilience. These are significant findings as they are not commonly recognised as elements of preparedness or resilience related to disaster risk reduction; nor are they commonly considered as targets for activities designed to mitigate the impact of disasters. When explored further to understand the community member perspective of why they considered stress or social exclusion as having a significant impact on an individual’s vulnerability related to disaster resilience they described:

‘Yes – ability to cope in times of stress and physical capacity to deal with crisis. Mental and physical strength so that you’re not frozen to deal with the stress and that you are physically able to meet the demand. Attachment to the community has a positive and negative context as the investment loss can be profound’

‘Not being a part of the community network increases risk. There are loners that live here that aren’t connected within the community’

Perceptions of disaster vulnerability varies between community demographic groups.

Several groups within and external to the community, were perceived to be at greater risk by the interview participants. Holiday homeowners, loners within the community, new community residents and tourists were considered at risk/vulnerable due to their perceived lack of local knowledge of the environment, the risk it posed and required preparedness to mitigate it, and lack of community connection. When the reason for the sense of vulnerability related to these groups was explored, in both cases the rationale was related to decreased levels of community connection described in theme 1. In the case of tourists, weekend homeowners and the elderly there was a perception of lowered community connection and involvement that decreased these populations risk knowledge and awareness. Coupled with this the elderly were perceived to be at greater risk due to potential mobility challenges, and both the elderly and children were considered as having greater need for support in times of crisis. Two interviewees who lived in the area but not in town perceived a difference in risk management between rural lot dwellers and those that lived in town. Key responses that informed this theme included:

‘When you have a lack of local knowledge. Tourists (sic) make us vulnerable when they come here and do things that put us at risk. We’re also vulnerable because we need them to support our economy; we just need to educate them when they come here’

‘Elderly, disaster communication is done by text messaging, may (sic) don’t have mobile phones and network coverage here is patchy’

‘Elderly, weekenders (they aren’t as prepared), elderly are more frail and more dependent in a time of crisis’

‘Kids in schools, people camping are isolated due to a lack of access’

‘Elderly due to isolation and decreased networks within the community, children due to dependency, not having phone coverage/communications’

‘Elderly due to lack of mobility, they have a greater dependency and need for transport and can become disconnected from the community’

'Yes, elderly as they aren't physically able to respond to local risks especially fire. Tourists have a lack of understanding and knowledge of the area and the risks and are less able to assess the risk. Weekenders are not well engaged with the community and don't understand the risks here. Children and teenagers are less engaged in local community activities and don't understand the community structure'

'Town dwellers are more vulnerable than out of town property owners. We are used to clearing the land and having burn offs of dead wood. We see the risks around us and our kids grow up with it and understand the dangers because we are regularly preparing for them'

'People that have no experience of previous events and emergencies. Living out of town means you have a greater reliance on your own skills to take care of yourself'

Disaster resilience is a function of good physical and mental health.

Both physical and mental health were consistently perceived to be of high value in relation to a person's capacity and resilience. Interestingly mental health was rated highest in significance related to an individual's disaster resilience compared to all other health determinants. This finding was also repeated in interview questions related to the participant's perception on the importance of health in reference to disaster resilience (question 6):

Yes, being able to care for people and participate in training'

'Yes, after a disaster to cope and recover mentally and physically. Particularly after the media stops and you're left alone'

'Yes, so you can cope with the disaster'

'Yes, so you have capacity to make decisions and not be bound by infirmity'

'Yes, it gives you a better chance of survival'

'Yes, so you are physically capable to act'

'Yes, poor health reduces your ability to respond or cope with a disaster'

'Yes, being able to respond without panicking, being strong mentally and having the capacity to respond'

'Yes, so you can respond to the threat'

'Yes, because from start to finish disasters affect your resilience. If you're fit and healthy (mind and body) you have greater ability to respond and recover and lift yourself up. It's going to be very important'

'Yes, it can affect how you cope mentally from a disaster and is related to your personal resilience'

Effective disaster planning requires community partnership and robust resource planning, risks awareness, communication and coordination in development, training and testing. Robust communication is an essential trait of disaster plans.

Community risk management and risk literacy with the focus on leadership and effective, local risk communication that meets the needs of the community were considered key to describing and operationalising disaster management plans. A clear described need for the access and provision of reliable, timely information at a recognised meeting location was evident in all interviewee responses. When describing the rationale for this need interviewees described:

'Having a designated controller/coordinator who is allocated early and that this is known early by all. Decide early on whether to go or to stay, having a preparedness pack if you are going to go, having meeting points for gathering (sic) identified'

'Who's in charge, having a hierarchy so there's no confusion when disaster hits, this keeps everyone together'

'Getting information out to communities, evacuation plans, knowing who's responsible for what. Everyone should know the plan, communicate the plan well before'

'Risk mitigation factors, first responders, welfare plans, recovery plans and how to apply them'

'Checklists, what to do's, alert levels for community, communication and information so they know when and how to respond'

'Having leadership described and defined and having a system to manage it all'

'Having a meeting point'

'Knowing how to mitigate against the risks, educating the community of the threats and what steps are in place to respond to them'

'It has to have a meeting point for the community, and it has to have someone coordinating'

'Having a pre-planned meeting point, someone to direct and control, having emergency shelter, supply of food, water and necessities'

'Public consultation, having the risks listed and having adequate resources'

'What the risks are, where you would go for information and back up plans for communication. A community meeting point, personal plans and community plans in place. Key people with key roles. Plans for how we manage short term post event, guides for emergency agencies post event'

'Communications, power supply, head count of the community, resupply of people's basic needs'

'The community should test plans like emergency services do. We need strong community engagement and know (sic) what the community expects to be in plans and to ensure that the community has a role in applying the plan'

'Share procedures and local knowledge within the community'

'Having a central communication point. When a disaster happens people want to know what's going on as soon as possible. Having a communication point reduces the risk of people listening to or acting on rumours. That's when they take things into their own hands and can end up hurt'

'Communication, essentials for survival (food, water, shelter). Plans should have actions that build trust within a community because we need to trust each other when it happens'

This study found that social exclusion (where an individual experiences poverty, social exclusion, and/or discrimination) was considered to have a significant impact on an individual's disaster resilience. This finding is consistent with research conducted by Norris et al who found that populations with low socio economic status are at greater risk of mental health consequences following a disaster, due to feelings of lack of self-worth and income stress [141]. A previously conducted literature review has identified lack of social support, female gender, prior traumas, resource loss, human loss and poor physical or mental health as likely indicators of psychological resilience to disasters [142]. The findings of this study are consistent with this literature review and serve to further exemplify the utilisation of Social Determinants of Health as indicators of community disaster resilience.

Community strength and connectedness was a feature of this study that was considered as a factor that enhanced a community members resilience. This connectedness was perceived as a strength as it facilitated support between community members. When describing a disaster resilient community, a resident suggested:

'Capacity to bind people together to help each other for protection at the time and then help each other to return to normal as soon as possible'

Social connectedness has been previously explored by Lacoviello et al in reference to the impacts of disaster. Their findings showed that supportive social networks increase an individual's resilience, and importantly, enhancement of them pre disaster impact had a positive effect on mitigating psychological trauma post event [143].

A low indication of the relationship between faith and resilience may be reflective of the secular nature of Australian society [144] or the localised nature and sample of our study. When compared to research in other areas of Oceania faith and religion have been found to be a common factor for resilience amongst survivors of tsunami [145]. Further to this, other western societies have found that older adult survivors reported faith and religious practice as coping mechanisms following a disaster [146].

Provision of information featured strongly in this research. This is consistent with the research findings of Norris et al who describe elements of adaptive capacities of communities affected by disaster [141]. These authors also identified that the lack of information created community stress, a finding consistent with a respondent in this research who reported that:

‘Being by yourself with no resources and without knowledge on what to do makes you vulnerable. A lack of information in the 2009 fires meant people were reacting to rumour and whispers of what was happening. You need a central point of communication, somewhere where the community can receive information and ask questions. Without this the community splits apart’

Maintaining trust and mitigating fracturing of communities during and after disasters is achieved by timely, factual communication from leadership [147, 148].

Significant barriers in accessing basic needs by older persons have also been reported which can exacerbate challenges faced by older persons in preparing and responding to disaster [146]. The interview respondents in this project consistently reported higher vulnerability of elderly residents in the community to disasters. Recent research investigating the impacts of Hurricane Katrina on older adults also found differences in risks in disasters compared to the community they reside in. Identified challenges included physical and psychological health barriers; and the inability to evacuate without assistance in preparation, transportation and pet care [149]. As noted by an interviewee:

‘Elderly due to lack of mobility, they have a greater dependency and need for transport and can become disconnected from the community’

This report contributes to the evolving research base investigating older persons in disasters [150, 151].

The World Health Organization’s (WHO) Risk Reduction and Emergency Preparedness Strategy for the health sector and community capacity development reflects the recommendations of a global consultation organised by the Health Action in crisis cluster. This strategic framework signals a shift from a traditional, short term focussed emergency management doctrine to one of capacity building, developing resilience and reducing vulnerability. The challenge in achieving this goal as described by the strategic framework, is ‘establishing systematic capacities, such as legislation, plans, coordination mechanisms and procedures, institutional mechanisms and budgets, skilled personnel, information and public awareness and participation that can measurably reduce future risks and losses. This strategy recognises the importance of applying a ‘whole of health’ approach and utilises the

WHO definition of health as the benchmark for intervention effectiveness. This strategic direction complements efforts in other areas, notably the agenda for Sustainable Development, and the Sendai Framework for action [26, 46].

The Australian Business Roundtable for Disaster Resilience and Safer Communities report found that to build greater resilience to natural disasters in our states and territories, the government should mainstream and embed resilience across all aspects of policy and decision making, prioritise resilience investments by considering their broader economic and social benefits, improve understanding of disaster risks, costs to society and resilience building activities to improve resilience, and collaborate and coordinate to build resilience and address the long-term costs of natural disasters [152].

6.2.9 Conclusion

The findings of this study are reflective of key international and national recommendations for strengthening community resilience and recognising health and social factors as actionable determinants of disaster resilience and vulnerability reduction. The study undertaken in this chapter informed adjunct studies described in the next chapter which explored non traditional disasters and health threats.

6.3 NON-TRADITIONAL DISASTERS AND HEALTH THREATS

6.3.1 Introduction

The findings of the previous chapter showed a community's perception of the importance of health determinants and disaster risk. This adjunct study explores how health determinants, when disrupted may become a threat or a disaster in their own right, and how such disasters are not always recognised within traditional paradigms of disaster assessment or measurement. Societal disruption can result in health threats not usually associated with emergency or disaster management frameworks. These frameworks are aligned to disaster definitions that are constructed around predefined categories developed from measurement of event impacts upon populations, largely driven by the construct of natural disasters. The study of disaster risk assessment is primarily informed by historical data that may not be sensitive to societal disruption or non-traditional health threats. The aim of this paper is to examine non-traditional disasters through the lens of disaster risk reduction, specifically 'residual risk' and consider whether contemporary disaster and health emergency risk reduction frameworks and practice can adapt to support action to reduce the impact of these non-traditional hazards.

The frequency of natural disasters is increasing, and the effects of these events result in public health crisis of the affected populations. Findings from the 2017 Lancet Countdown on Health and Climate Change noted a 46% increase in the frequency of weather related disasters since the year 2000 and noted that the burden of deaths associated with disasters caused by natural hazards predominantly affects poorer countries[98]. At a national level, the Australian Department for Climate Change has recognised that the increasing frequency

and intensity of extreme weather events increases risk to the built and natural environments, and the National Strategy for Disaster Resilience has identified that disasters are increasing in their complexity and frequency[9].

The World Health Organization's (WHO) Risk Reduction and Emergency Preparedness Strategy for the health sector and community capacity development reflects the recommendations of a global consultation organized by the Health Action in Crisis cluster[5]. This strategic framework signals a shift from traditional, short term focused emergency management doctrine to one of capacity building, developing resilience and reducing vulnerability. The challenge in achieving this goal as described by the strategic framework, is 'establishing systematic capacities, such as legislation, plans, coordination mechanisms and procedures, institutional mechanisms and budgets, skilled personnel, information and public awareness and participation that can measurably reduce future risks and losses'[5]. This strategy recognises the importance of applying a 'whole of health' approach and utilises the WHO definition of health as the benchmark for intervention effectiveness. This strategic direction complements efforts in other areas, notably the agenda for Sustainable Development, and the Sendai Framework for Action.

The emergence of non-traditional health threats has created further complexity and challenge in disaster and emergency management. The public health consequences of the Hazelwood mine fire (2014) and the recent thunderstorm asthma (2017) event in Victoria, which resulted in a reported eight deaths, an 8,500 patient surge in pre hospital and hospital attendances, and a broadcast of public health alerts has indicated the emergence of new public health emergencies. The aim of this paper was to examine emerging causes of disasters and non-traditional health threats, consider their relationship to contemporary emergency management risk assessment, and consider what is required for emergency management to adapt and confront this emerging reality.

6.3.2 Peer reviewed published paper: Non-traditional health threats: redefining the emergency management landscape

ABSTRACT

The study of disaster risk is primarily aimed at identifying who may be at risk (vulnerable populations) from specific events (causes) so as to prevent and/or facilitate timely responses to them. These causes are predominantly defined by historical data rather than from forecasting potential risks. Many of the threats to health and security today are trans-national, whether it is the spread of an infectious disease, migration of displaced people, or the widespread impact of a weather event. There is a paucity of discussion and literature that attempts to describe new and emerging causes of disasters, or the potential impact of these events. Reasons for this may include perceptions of these causes as being non-traditional threats and, therefore, not readily interpreted as causes of disasters and thus not as disasters at all. They may include climate change, social disruptions such as terrorism, economic crisis, drug trafficking or increased drug usage. The risks and impacts are changing because of societal and social change, economic changes and rapidly changing technology and interconnectedness. Traditional views of disaster are limiting, as they do not include high-impact events that are not associated with emergency service responses. The health consequences of these events are complex to understand. Nevertheless, careful analysis of these events reveals alignment of their human impact against established criteria that define disasters. The aim of this paper is to examine emerging causes of disasters and non-traditional health threats, consider their relationship to contemporary emergency management risk assessment, and consider what is required for emergency management to adapt and confront this emerging reality.

Non-traditional health threats: redefining the emergency management landscape

Joseph Cuthbertson¹, Emeritus Professor Frank Archer¹,
Dr Andy Robertson² and Jose M. Rodruguez-Llanes³

1. Monash University, Melbourne, Victoria.

2. Western Australia Department of Health, Perth, Western Australia.

3. European Commission Joint Research Centre, Brussels, Belgium.

Submitted: 20 May 2016. Accepted: 21 May 2017.

Introduction

In his First National Security Statement to Parliament on 4 December 2008, the then Australian Prime Minister, Kevin Rudd, broadened the consideration of traditional threats to national security to include that 'new and emerging challenges represent emerging non-traditional threats' (e.g. climate change, cyber security, food security, energy security, trans-national crime, globalisation and demographic changes), which introduce further sources of vulnerability in the Australian community (Rudd 2008). To these, financial collapse, economic crisis and the public health consequences of cascading natural disasters could be added (Little 2002). Other authors (Barnes, Bergin & Nicola 2014) have placed this Prime Ministerial Statement as the pivotal point in initiating an awareness of non-traditional threats in the Australian context. A 2015 Monash University Disaster Resilience Initiative (MUDRI) Forum, entitled 'Broadening Resilience to Emerging Non-traditional Events', and a 2016 national conference on this theme further consolidated non-traditional events on the national landscape for emergency management.

The *National Strategy for Disaster Resilience* has identified that disasters are increasing in their complexity and frequency (Attorney-General's Department 2011). Priorities for prevention and mitigation have been firmly embedded within this strategy; however, this is dependent on a whole-of-government approach to analyse and manage causal factors of disasters to achieve disaster risk reduction. Further support for action on activities that enhance mitigation, risk awareness and disaster risk reduction were demonstrated in the final report of the Productivity Commission (Productivity Commission 2014), which was accepted by the Australian government in 2016 (Attorney-General's Department 2016).

Background: emerging disaster risk

The theme of non-traditional threat and emerging disasters, and the need to develop robust risk assessment practices, is evident when analysing contemporary global events. The rapid destabilisation in political relationships between East and West was not predicted, nor the extent or speed to which this occurred. Breakdown in relationships resulting in government destabilisation contributes to protracted population emergencies, such as the

Ukrainian Crisis and the Syrian refugee crisis in Europe (Guha-Sapir *et al.* 2015).

Arnold (2002) postulated that future disaster risks during this 21st century would include: population growth, environmental degradation, global warming, deforestation, infectious diseases, hazardous materials, chemical warfare, nuclear risks, economic imbalance and cultural tribalism. Further to this, Arnold predicted that 'there will be more natural and anthropogenic disasters of every type, as well as some not yet imagined'.

Burkle (2010) identified the evolving nature of complex emergencies and the globalisation of public health emergencies. The effects of conflict, climate change, large-scale natural disasters, globalisation and urbanisation, epidemics and pandemics, and emergencies of scarcity are identified from the current burden of humanitarian action as future indices of risk (Burkle 2010). In the context of change in the nature and scale of crisis, Burkle emphasises the importance of public health practice as essential for community support and protection. The premise of this assertion is based on public health being a multi-disciplinary practice, which is case- and population-focused rather than individual- and treatment-focused and establishes health as the goal of interventions.

In March 2015, Sendai hosted the UNISDR conference for disaster risk reduction. The program of presentations over four days contained 10 separate sessions devoted to emerging risk, constituting five hours of working presentations and committing nearly 20 per cent of conference time to examination of this single topic. Topic areas included rural resilience, lessons from mega disasters, global risk trends, water resource management, ecosystem management and resilience, disaster risk and poverty, epidemic and pandemic risk, economic risks of disaster risk reduction, land-use planning and disaster risk reduction, disaster and climate risk (UNISDR 2015). This array of sessions provided a broad cross-section of new and potentially evolving threats. In particular, the Global Risk Trend presentation sought to analyse the current disaster risk environment. It identified that the disaster risk environment is increasing and that many countries 'have understood and practiced disaster risk reduction as disaster management' (UNISDR 2015). The outcome of these efforts is an improvement in response capacity, and minimal impact on risk mitigation or management.

Furthermore, descriptors of risk areas within the report (i.e. poverty, employment, and environment) display strong correlation with the contemporary social determinants of health approach (Marmot *et al.* 2008).

While these findings are important in the context of identifying and improving disaster risk, risk and cause are not synonymous. The Global Risk Report (World Economic Forum 2015) provides an updated analysis of risk and factors impacting risk variance. There is opportunity to complement these efforts through further examination of current and emergent disaster cause and threat. Contextualising threat and risk analysis

can assist in appropriate investment for planning and prevention strategies.

Burkle, Martone and Greenough (2014) reviewed contemporary trends in humanitarian action and proposed that the scale and complexity of disasters is changing and that current emergency and humanitarian operational frameworks will be unable to meet future needs. The ecological, social and economic effects of climate change, extreme weather events, unsustainable urbanisation, biodiversity crisis, scarcity of resources, increasing armed conflict and lack of pandemics have been suggested as future, and likely interacting, threats to community health and wellbeing. The challenge of anticipating disasters promoted by the concept of resilience (Murray & Ebi 2012) can be achieved on the condition of being aware of their existence and root causes.

Non-traditional health threats and climate change

Burkle (2013) examined emerging disasters in the setting of climate change and highlights the disconnect between leadership and science. He provides commentary on an editorial published in *Nature* by an investment strategist. A gap in health research influence on policymakers and government leaders, as compared to the closer relationship that economists have established, is noted. Jeremy Grantham, the investment strategist and author of the editorial, calls on health professionals to be greater advocates for the health impacts of global warming. Achieving this will require health professionals and scientists to step beyond the traditional publication and conference presentations to communicate to a broader audience. Burkle notes this will invariably come with challenges and risks. In addition, Grantham proposes that these efforts need to be more realistic, more persuasive and gain better traction with government leaders (Burkle 2013). The context of this review highlights climate change as an emerging threat to health and demonstrates the need for coordinated, multi-disciplinary practice in the setting of action on disaster risk reduction. Of particular relevance is that this call is from a professional outside of health to the scientific community for action; a call that should bring into question not only what we do, but also to whom we communicate and how to achieve an effect.

The second volume of the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report examined impact adaptation and vulnerability. In particular, the human health chapter identifies future risks relative to climate change and, as in many cases of health disparity, the greater burden of impact is expected to occur in poor and vulnerable groups, exacerbating health inequalities (Field *et al.* 2014). This action is reflective of the IPCC report identifying injuries, hospitalisations and deaths due to intense heatwaves as a significant health impact category, and evidence associating poor health outcomes

associated with extreme heat exposure in the workplace (Kjellstrom, Homer & Lemke 2009).

The effect of extreme weather events is emerging in Australia (Tong *et al.* 2014). At a national level, the Australian Department for Climate Change has recognised the increasing risk to the built and natural environment posed by increasing frequency and intensity of extreme weather events. Heatwave impact on southern Australia has, in some states, shifted the responsibility of preparedness, response and recovery to emergency management sections of government. The assignment of responsibility to emergency management structure contextualises a shift in perception and application of traditional disaster definition to developing, non-traditional threats (Schipper & Pelling 2006).

Non-traditional health threats and social disruption

Urban population growth has expanded rapidly and, in many cases, in an unsustainable manner. UN-Habitat reported on the trend in urbanisation, with the majority of the global population now existing in urban spaces compared to rural living (UN-Habitat 2013). This trend is expected to continue and the consequences will be multi-faceted. Increased demand on lands in urban spaces will drive the need for resources and subsequent increased pressure on the environment through exploitation of resources or via increased emission outputs. A high proportion of this demand is in coastal regions to access ports and transport infrastructure. These same areas are also under increasing threat from weather-related events and climate change; further compounding the risk associated with unsustainable urbanisation (Burkle 2010). That and other impacts, such as increased prevalence and spread of disease in urban slums, are evident; the full effects are yet to be realised.

Using disaster definitions and descriptors applied by UNISDR (UNISDR 2009), the impact of illegal drug use and trafficking represents a contemporary, societal disaster. The impact of drug trade and usage on society is rapidly increasing. In 2012, the Australian Institute of Criminology reported Oceania as having the highest global usage and trade of methamphetamine, also known as 'ice' (Schloenhardt 2007). In Indonesia, President Joko Widodo has stated that 'Indonesia is in a state of emergency with regard to drug use' (Times 2014). The emerging impact of methamphetamines in Victoria has been labelled a crisis and led to the establishment of a workforce appointed by the incumbent government in response to a parliamentary report. The Victorian Police have publicly stated that 'we can't simply arrest our way out of this crisis. We need to get to the heart of the problem and listen to the experts who see the effects of this tragedy every single day.' The importance of revealing the underlying causes of these invisible crises are exemplified in recent studies by Case and Deaton. These authors recently revealed a disproportionate upward trend in mortality rates due to drug overdose, alcohol and suicide among white male US Americans,

calling them 'deaths of despair' (Case & Deaton 2017). Determinants associated with this trend were economic distress and high unemployment in working class populations without university education. Importantly, as in the case of drought, these social disasters unfold progressively. In America this trend emerged in the late 20th century with the move of manufacturing centres to Asia and increased as these population groups were impacted by the Global Financial Crisis of 2008. The same crisis had public health impacts in many European countries (Stuckler *et al.* 2011). Emerging research is now able to demonstrate the connection between a political decision, such as austerity measures, and the connection to health deterioration (Robertson 2011).

Additionally, like many commonly recognised disasters, this impact extends across borders and countries in a globalising world, and disproportionately affects vulnerable groups within communities. While addiction has previously been identified as a causal factor of poor health, it is not construed as a risk factor within emergency management paradigms and, as a consequence, the capacity to operationalise either addiction programs or trafficking action is limited, if not non-existent. The recognition of the complexity of illicit drug impact should be heeded as a call to collaborative action across professions to engage in action. Public health practice has a unique and valuable skillset to offer, and should be engaged by leadership in this field, particularly in understanding the social environment favouring drug use and addiction.

Domestic violence has been reported as the cause of one death per week of women in Australia (Chan & Payne 2013) and one in three women have experienced violence since 15 years of age (Cox 2015). The magnitude and impact of these events meets conceptual definition of a diffuse disaster as a primary event. Recent national and state inquiries have resulted in the adoption of targeted strategies to address this national imperative. Many of the proposed strategies reflect attributes of a public health and disaster risk reduction approach.

While there is not a single agreed definition of domestic violence in Australia, Parkinson and Zara (2013) referred to domestic violence as a 'hidden disaster' in their research that identified an increase in domestic violence post-Australia's Black Saturday bushfires. In this context the impact of domestic violence could be considered a secondary event associated with the recovery phase following the initial event. Domestic violence is also included as a 'chronic stressor' in the Resilience Strategy, auspiced by the Rockefeller Foundation's 100 Resilient Cities program. Akin to many disasters the long term impact on health attributable to domestic violence is poorly understood and underpins a need to examine emergency management frameworks to address awareness and action on domestic violence as both a primary and secondary disaster event.

Discussion

Considerations for action and public health interconnectedness with emergency management

Non-traditional health threats are difficult to define, as definitions of disaster vary and are contextual to need and to governmental purpose to apply disaster definitions for the application and enabling of support services. However, research institutions may apply definitions for data gathering purposes. The Centre for Research and Epidemiology of Disasters defines a disaster as 10 or more people deceased and/or greater than 100 injured and/or declaration by the country of a state of emergency and/or an appeal for international assistance (Guha-Sapir *et al.* 2012). Non-traditional threats are not easily recognisable as disasters by emergency managers yet, when compared to currently accepted types of disasters, the impact on individuals is as significant, if not more so. A comprehensive approach to reduce disaster risk was mandated in the United Nations *Sendai Framework for Disaster Risk Reduction*, whose declaration was 'to enhance efforts to strengthen disaster risk reduction and to reduce disaster losses of lives and assets from disasters worldwide' (Glantz 2015). A comprehensive approach requires a deeper understanding of the drivers of disaster risk and challenges traditional norms of hazard and vulnerability assessment.

Ranson (1993), a forensic pathologist in Melbourne, coined the term 'The Diffuse Disaster Syndrome'. Ranson suggests that 'what separates the diffuse disaster from the mass disaster is its temporal and spatial distribution with deaths and injuries taking place as isolated events that are not easily recognised as being related. As an example, large droughts in the Horn of Africa causing famine and death are more visible than smaller, long-term droughts but are still responsible for many deaths. In a slow-onset, invisible crisis like this, deaths will not be temporally or spatially aggregated and thus difficult to attribute to the drought. It is only by bringing cases together that the impact of such deaths on community can be fully appreciated and the resources needed to research the mechanisms that result in these deaths be appropriately addressed (Ranson 1992). On this basis, road trauma, workplace death and injury, child abuse, domestic violence, youth suicide, opiate and 'ice' epidemics could be structured as 'diffuse disasters'. They could be approached and studied through a public health lens, an approach that has seen the national road toll reduced dramatically since the 1970s. One implication is that national and international disaster databases (e.g. CRED, Australian Disaster Information) would need to capture new fields. At present, an examination of both these databases suggests that data variables to capture and to examine disasters are not adequate. The 2015 Monash Disaster Resilience Initiative Forum on this theme strongly supported the proposal that these non-traditional events would benefit from examination

through a disaster risk reduction lens. A strategy of resilience-thinking and analysis would provide greater focus on the study on the long-term health consequences of disasters.

As new threats emerge and causal factors are identified, emergency management practice will require evolution beyond traditional response-based frameworks. An increasingly connected world requires collective action to address complex problems that arise. Public health practice, as an evidence-based means of enquiry and action, can provide a solid foundation for future practitioners (Keim 2008). Epidemiology is a fundamental toolbox to systematically investigate the underlying (sometimes distal) drivers of these societal or diffuse disasters, not just vulnerable groups and their age or sex.

Increasing connectedness across nations has led to the emergence of global public health practice. As boundaries between nations and continents decrease, variations in health threats are evolving as common concerns and require commitments in global health to address them (Labonté & Schrecker 2007).

Governments face complex challenges in the face of changing disaster profiles. Demands to maintain constituent support can shift political objectives from long-term structural solutions to more popular short-term agendas. Contributing to this is that many of the factors are often outside a single government's control. Economic and environmental change, regional population shifts, and climate-related events affecting regional security have domestic consequences. Solutions to these require collaborative efforts for enduring success and require sound, strategic leadership to engage societal support (Clark 2012). Delays in achieving this will make impacts more severe and mitigation more costly (World Bank 2013).

Schipper and Pelling (2006) previously examined interconnectedness across broad policy areas of disaster risk, climate change and international development. Specifically, they note that the divide between these disciplines requires bridging to ensure that projects to address needs are complementary, not conflicting (Schipper & Pelling 2006). Recommendations are provided for improved interaction and integration between these communities of practice to reduce overlap, and provide uniformity in language and methods (Schipper & Pelling 2006).

Further action in 2015 included the conclusion of the Millennium Development Goal project and the initiation of the Sustainable Development Goals as their successor. The opportunity to achieve action on causal factors of health is inextricably linked to disaster vulnerability and sustainable development (United Nations 2014). Helen Clark, former New Zealand Prime Minister and United Nations Development Program Administrator, has highlighted the interconnectedness of resilience and sustainable development. Significantly, Clark identifies resilience-based activity with developmental programs as not only a responsible course of action, but one that is practicable, delivers the greatest output and aligns sustainable development-based activity

with aims described within strategic disaster risk reduction policy. This proposal draws practitioners together towards common goals and emphasises the need for comprehensive analysis of need and long-term commitment to reduce vulnerability (Clark 2012). A global public health agenda linking these initiatives is imperative to ensure optimum results are delivered from future projects. The scientific community may support these initiatives by identifying drivers and outcome indicators common to sustainable development, resilience and disaster risk reduction.

At a pragmatic level, the public health consequences of the Hazelwood mine fire in Victoria (Victorian Government 2014) and the 2017 'thunderstorm asthma' event in Victoria, which resulted in a reported nine deaths, an 8500 patient surge in ambulance and emergency department attendances over one evening, and a broadcast of public health alerts (Guest 2016) suggests a priority in re-examining these non-traditional events through a new, but complementary, lens.

Conclusion

Broader examination of emerging disasters and non-traditional health threats is fundamental to understanding the health of communities and the vulnerabilities within them (Keleher & MacDougall 2009, Marmot, *et al.* 2005) particularly in a rapidly changing and globalising world. Once exposed, the effects of disaster on vulnerable groups can be magnified, resulting in marginalisation and increased suffering. Vulnerability arises from social, cultural, health and environmental interactions (Lindsay 2003); as such no single agency is equipped to adequately respond to identified needs and a multi-disciplinary approach is required. Further examination of emerging disasters and non-traditional health threats is warranted. However, the challenge for the emergency management discipline is to examine this in more depth and re-evaluate contemporary practice (Paul & Raisa 2012). Research and case study analysis of specific non-traditional disasters and emerging threats in Australian emergency management is recommended and will provide opportunity to redefine risk and develop a dialogue for future practice.

References

Arnold JL 2002, *Disaster medicine in the 21st century: future hazards, vulnerabilities, and risk*. *Prehospital and Disaster Medicine*, vol. 17, pp. 3-11.

Attorney-General's Department 2011, *National Strategy for Disaster Resilience 2011*. At: www.ag.gov.au/EmergencyManagement/Documents/NationalStrategyforDisasterResilience.PDF.

Attorney-General's Department 2016, *Australian Government response to the Productivity Commission Inquiry into Natural Disaster Funding Arrangements*. At: www.ag.gov.au/Publications/Pages/australian-government-response-to-the-productivity-commission-inquiry-into-natural-disaster-funding-arrangements.aspx.

Barnes P, Bergin A & Nichola D 2014, *Working as one: A road map to disaster resilience for Australia*.

Burkle FM Jr 2010, *Future humanitarian crises: challenges for practice, policy, and public health*. *Prehospital and Disaster Medicine*, vol. 25, p. 191.

Burkle FM Jr 2013, *Pondering to ignorance on climate change: lessons from an investment strategist*. *Prehospital and disaster medicine*, vol. 28, pp. 200-201.

Burkle FM Jr, Martone G, Greenough PG 2014, *The changing face of humanitarian crises*. *Brown J World Affairs*, vol. 20, pp. 25-42.

Case A & Deaton A 2015, *Rising morbidity and mortality in midlife among white non-Hispanic Americans in the 21st century*. *Proceedings of the National Academy of Sciences*, vol. 112, pp. 15078-15083.

Case A & Deaton A 2017, *Mortality and morbidity in the 21st Century*.

Chan A & Payne J 2013, *Homicide in Australia: 2008-09 to 2009-10 National Homicide Monitoring Program annual report*. Australian Institute of Criminology, Canberra Australia. At: www.aic.gov.au.

Clark H 2012, *Putting Resilience at the Heart of the Development Agenda*. Cambridge, United Kingdom.

Cox P 2015, *Violence Against Women in Australia: Additional Analysis of the Australian Bureau of Statistics' Personal Safety Survey, 2012*. ANROWS.

Field CB, Barros VR, Mach K & Mastrandrea M 2014, *Climate change 2014: impacts, adaptation, and vulnerability*. Cambridge University Press Cambridge, New York, NY.

Glantz M 2015, *The Letter and the Spirit of the Sendai Framework for Disaster Risk Reduction (a.k.a. HFA2)*. *International Journal of Disaster Risk Science*, vol. 6, pp. 205-206.

Guest C 2016, *Thunderstorm asthma - 22 November 2016*. In: *SERVICES*, D. O. H. A. H. (ed.). Victoria.

Guha-Sapir D, Rodriguez-Llanes JM, Hicks MH, Donneau AF, Coutts A, Lillywhite L & Fouad FM 2015, *Civilian deaths from weapons used in the Syrian conflict*. *British Medical Journal (Online)*, p. 351.

Guha-Sapir D, Vos F, Below R & Penserr ES 2012, *Annual disaster statistical review 2011: the numbers and trends*. UCL.

Keim ME 2008, *Building human resilience: the role of public health preparedness and response as an adaptation to climate change*. *American Journal of Preventive Medicine*, vol. 35, pp. 508-516.

Kelehe RH & Macdougall LC 2009, *Understanding health: a determinants approach*. South Melbourne, Victoria, Oxford University Press.

Kjellstrom T, Holmer I & Lemke B 2009, *Workplace heat stress, health and productivity - an increasing challenge for low and middle-income countries during climate change*. *Global Health Action*, p. 2.

Labonté R & Schrecker T 2007, *Globalization and social determinants of health: Introduction and methodological background (part 1 of 3)*. *Globalization and Health*, vol. 3, p. 5.

Lindsay J 2003, *The Determinants of Disaster Vulnerability: Achieving Sustainable Mitigation through Population Health*. *Journal of the International Society for the Prevention and Mitigation of Natural Hazards*, vol. 28, pp. 291-304.

Little RG 2002, *Controlling cascading failure: Understanding the vulnerabilities of interconnected infrastructures*. *Journal of Urban Technology*, vol. 9, pp. 109-123.

Marmot M, Friel S, Bell R, Houweling TA, Taylor S & Health COSDO 2008, *Closing the gap in a generation: health equity through action on the social determinants of health*. *The Lancet*, vol. 372, pp. 1661-1669.

Murray V & Ebi KL 2012, *IPCC special report on managing the risks of extreme events and disasters to advance climate change adaptation (SREX)*. BMJ Publishing Group Ltd.

Parkinson D & Zara C 2013, *The hidden disaster: Domestic violence in the aftermath of natural disaster*. Australian Journal of Emergency Management, vol. 28, no. 2, p. 28.

Paul AB & Raisa K 2012, *Integration of Social Determinants of Community Preparedness and Resiliency in 21st Century Emergency Management Planning*. Homeland Security Affairs U6, p. 8.

Productivity Commission, P. 2014. *Natural Disaster Funding Arrangements, Inquiry Report no. 74*. In: COMMISSION, P. (ed.). Canberra.

Ranson D 1993, *The role of the Pathologist in Homicide Investigations and Coronial Inquiries. Homicide: patterns, prevention and control*. Australian Institute of Criminology, Canberra.

Robertson AG 2011, *The health consequences of economic crises*. Taylor & Francis.

Rudd K 2008, *The first national security statement to the Australian parliament. Public address. 4 December 2008*.

Schipper L & Pelling M 2006, *Disaster risk, climate change and international development: scope for, and challenges to, integration*. Disasters, vol. 30, pp. 19-38.

Schloenhardt A 2007, *The market for amphetamine-type stimulants and their precursors in Oceania*. Australian Institute of Criminology, Canberra, p. 81.

Stuckler D, Basu S, Suhrcke M, Coutts A & McKee M 2011, *Effects of the 2008 recession on health: a first look at European data*. The Lancet, vol. 378, pp. 124-125.

Times TB 2014, *Indonesia in State of Emergency over Drugs: President*. The Bali Times. At: www.thebalitimes.com/2014/12/15/indonesia-in-state-of-emergency-over-drugs-president/.

Tong S, Wang XY, Yu W, Chen D & Wang X 2014, *The impact of heatwaves on mortality in Australia: a multicity study*. BMJ open, vol. 4, e003579.

UN-Habitat 2013, *Planning and design for sustainable urban mobility: Global report on human settlements 2013*, Taylor & Francis. At: <https://unhabitat.org/planning-and-design-for-sustainable-urban-mobility-global-report-on-human-settlements-2013/>.

United Nations 2014, *Disaster Risk Reduction and Sustainable Development. Seventh Session of the United Nations General Assembly Open Working Group on Sustainable Development Goals*. At: <https://sustainabledevelopment.un.org/index.php?menu=1679>.

UNISDR 2009, *UNISDR Terminology on disaster risk reduction*. At: www.unisdr.org/we/inform/publications/7817.

UNISDR 2015, *Third United Nations World Conference on Disaster Risk Reduction*. At: www.wcdrr.org/.

Victoria Government 2014, *Hazelwood Mine Fire Inquiry Report*. At: www.report.hazelwoodinquiry.vic.gov.au/introduction.html.

World Bank 2013, *Building Resilience: Integrating climate and disaster risk into development. The Lessons from the World Bank Group experience*. The World Bank, Washington DC. At: <http://documents.worldbank.org/curated/en/762871468148506173/pdf/826480WPOv10Bu0130Box379862000U0090.pdf>.

World Economic Forum 2015, *Global Risks 2015: Tenth Edition*. Geneva. At: *Global Risks 2015: Tenth Edition*. Geneva. At: www.weforum.org/docs/WEF_Global_Risks_2015_Report15.pdf.

About the authors

Joseph Cuthbertson is a Paramedic in Perth, Western Australia and works in clinical quality and safety for a regional health authority. He has worked in the prehospital field for the last 15 years in clinical, aeromedical retrieval, disaster health management and governance roles. He is undertaking a PhD at Monash University examining Disaster Health practice.

Emeritus Professor Frank Archer is Director of the Monash University Disaster Resilience Initiative within the Monash University Accident Research Centre.

Dr Andy Robertson is Deputy Chief Health Officer and Director at WA Department of Health.

Dr Jose M Rodriguez-Llanes is a scientific officer at the European Commission Joint Research Centre. He is currently investigating the measurement of resilience to food and nutrition security in disaster and conflict context with a focus on Africa and Asia.

6.3.3 Discussion

Many of the threats to health and security today are trans-national, whether it is the spread of an infectious disease, migration of displaced people, or the widespread impact of a weather event. There is a paucity of discussion and literature that attempts to describe new and emerging causes of disasters, or the potential impact of these events. Reasons for this may include perceptions of these causes as being non-traditional threats and, therefore, not readily interpreted as causes of disasters and thus not as disasters at all. They may include climate change, social disruptions such as terrorism, economic crisis, drug trafficking or increased drug usage. The risks and impacts are changing because of societal and social change, economic changes and rapidly changing technology and interconnectedness. Traditional views of disaster are limiting, as they do not include high-impact events that are not associated with emergency service responses. The health consequences of these events are complex to understand. Nevertheless, careful analysis of these events reveals alignment of their human impact against established criteria that define disasters.

This chapter explored non-traditional disasters and health threats. Societal disruption as both a cause and a result of disaster. Inclusion of these health impacts should be considered within the landscape of disaster impact measurement and disaster risk management. The next chapter will provide a focussed exploration of health impacts not measured, assessed or treated by traditional disaster risk reduction practices.

6.4 Societal disruption as a disaster. Exploring suicide, addiction and domestic violence in Australia through a disaster risk reduction lens

6.4.1 Introduction

This chapter describes a focussed exploration of several non-traditional health impacts utilising a disaster risk reduction lens. The health impact of illegal prescription and synthetic drug use, suicide and domestic violence in Australia were examined as contemporary, public health emergencies. The mortality and morbidity of victims, the individual and cumulative health impact of the affected families and society as a whole and the significant consumption of medical and financial resources and lost productivity of these crisis meets internationally recognised definitions of a disaster. As with many commonly recognised disasters their impact as non-traditional health and security threats extends across borders and countries and disproportionately affects vulnerable populations within communities [79, 153]. The following paper was accepted for publication in the United Nations Global Risk Report 2022.

6.4.2 Peer reviewed paper accepted for publishing: Societal disruption as a disaster. Exploring suicide, addiction and domestic violence in Australia through a disaster risk reduction lens



Global Assessment Report on Disaster Risk Reduction

2022

CONTRIBUTING PAPER

**Societal disruption as a disaster.
Exploring suicide, addiction and domestic
violence in Australia through a disaster risk
reduction lens**

Joseph Cuthbertson
Frank Archer
Andy Robertson
Jose M. Rodriguez-Llanes

Disclaimer:

The designations employed and the presentation of the material in this publication do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations concerning the legal status of any country or territory or of its authorities or concerning the delimitations of its frontiers or boundaries. The designations of country groups in the text and the tables are intended solely for statistical or analytical convenience and do not necessarily express a judgment about the stage reached by a particular country or area in the development process. Mention of the names of firms and commercial products does not imply the endorsement of the United Nations.

Note: The designations employed and the presentation of maps in this report do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations concerning the legal status of any country, territory, city or area or of its authorities or concerning the delimitation of its frontiers or boundaries.

Some rights reserved. This work is made available under the Creative Commons Attribution-NonCommercial 3.0 IGO licence (CC BY-NC IGO); <https://creativecommons.org/licenses/by-nc/3.0/igo/legalcode>

Under the terms of this licence, this work may be copied, redistributed and adapted for non-commercial purposes, provided that the work is appropriately cited. In any use of this work, there should be no suggestion that UNDRR endorses any specific organization, products or services.

The use of the UNDRR logo is not permitted. If a translation of this work is created, it must include the following disclaimer along with the required citation below: "This translation was not created by the United Nations Office for Disaster Risk Reduction (UNDRR). UNDRR is not responsible for the content or accuracy of this translation. The original English edition shall be the authoritative edition."

Users wishing to reuse material from this work that is attributed to a third party, such as tables, figures or images, are responsible for determining whether permission is needed for that reuse and for obtaining permission from the copyright holder. The risk of claims resulting from infringement of any third-party-owned component in the work rests solely with the user. Sales, rights and licensing.

UNDRR information products are available for non-commercial use. Requests for commercial use, rights and licensing should be submitted via: <https://www.undrr.org/contact-us>

This publication may be freely quoted but acknowledgement of the source is requested.

Citation: UNDRR (YYYY), *Insert full name of publication*, United Nations Office for Disaster Risk Reduction (UNDRR).

© 2022 UNITED NATIONS OFFICE FOR DISASTER RISK REDUCTION

For additional information, please contact:

United Nations Office for Disaster Risk Reduction (UNDRR)
9-11 Rue de Varembé, 1202 Geneva, Switzerland, Tel: +41 22 917 89 08

Societal disruption as a disaster. Exploring suicide, addiction and domestic violence in Australia through a disaster risk reduction lens

Abstract

Some types of societal disruption can result in health threats and impacts not usually associated with emergency or disaster management frameworks. These frameworks are most commonly aligned to disaster definitions that are largely oriented towards predefined rapid onset hazards, often causing disasters. Disaster risk management is primarily informed by historical data that may not be sensitive to societal disruptions or non-traditional health threats. The aim of this paper is to review the impact of drug addiction, domestic violence and suicide in Australia through the lens of disaster risk reduction. We ask whether they can be considered as disasters themselves according to thresholds and definitions; and whether contemporary health emergency and disaster risk management (HEDRM) practice can be adapted to support action to reduce the impact of these events and inform disaster risk reduction.

Key words: Societal disruption, suicide, drug addiction and domestic violence, disaster risk reduction, Australia

Contents

Introduction	3
Methods.....	5
Results.....	6
Discussion	8
References	12

Introduction

A disaster, as defined by UNDRR is ‘a serious disruption of the functioning of a community or a society at any scale due to hazardous events interacting with conditions of exposure, vulnerability and capacity, leading to one or more of the following: human, material, economic and environmental losses and impacts’ (UN, 2016). A slow-onset disaster is defined as one that unfolds gradually over time (UN, 2016). The Sendai Framework for Disaster Risk Reduction 2015-2030 identifies events such as drought, desertification, sea-level rise, and epidemic disease as potential slow onset disasters (UNISDR, 2015). Ranson has described episodic events with dispersed spatial and temporal distribution as ‘diffuse disasters’ (Ranson, 1993).

At the national level, the Australian Disaster Resilience Knowledge Hub uses criteria to define a disaster (Table 1). These criteria vary a little but are largely consistent with those used by the International Disaster Database EM-DAT, often used to inform international reports on impacts of disasters.

Table 1. Disaster Definitions by impacts

Category	Criteria	
	Australian Disaster Resilience Knowledge Hub (NDRRF, 2017)	EM-DAT database (EM-DAT, 2021)
Deaths	3, or	Ten (10) or more, or
Injuries or illnesses / People affected	20 Injuries or illnesses, or	One Hundred (100) or more people affected, or
Impact	Significant damage to property, infrastructure, agriculture or the environment; or disruption to essential services, commerce or industry at an estimated total cost of A\$10 million or more at the time the event occurred	Estimated damage is reported but not listed as a criteria
Other criteria		Declaration of a state of emergency, or Call for international assistance

The 2008 Australian National Security Statement described demographic changes as a potential source of increasing vulnerability to disasters in the Australian community (Rudd, 2008). The statement propelled awareness of non-traditional health threats such as climate change, cyber security, food security, energy security, trans-national crime, globalisation and demographic changes being considered in national security. The Australian National Strategy for Disaster Resilience (NSDR) describes disaster resilience as an approach that seeks to ensure capacity to adapt to new and emerging hazards, reduce exposure to risks, and recover from disasters effectively (COAG, 2011).

The NSDR also identifies several areas of emerging risk and describes a range of social determinants related to disaster vulnerability. This includes changing work-life patterns, lifestyle expectations, demographic changes, domestic migration, and community fragmentation. The Strategy recognises interdependencies of social, technical, and infrastructure systems with disasters and considers risks and risk treatments across the social, built, economic and natural environments (COAG, 2011). As a result, the Strategy prioritises actions to recognise and understand the risks disasters pose to the interests of Australian communities.

This report reviews the extent to which drug addiction, domestic violence and suicide in Australia should be considered through the lens of the Sendai Framework for Disaster Risk Reduction 2015-2030 (UNISDR, 2015). The goal of the Sendai Framework is ‘the substantial reduction of disaster risk and losses in lives, livelihoods and health and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries’; with ‘a more explicit focus on people and their health and livelihoods’ (UNISDR, 2015). Achievement of this goal is driven by seven targets shown in figure 1.

Figure 1. Targets of the Sendai Framework 2015 - 2030



(UNISDR, 2015)

The Sendai Framework recognizes two groups of hazards: natural and human-induced and identifies societal hazards as one of the five sub-types of human induced disasters (UNISDR, 2015). Contemporary commentary of disasters has led to the questioning of the terminology of ‘natural disaster’, that disasters are related to human influence, and the more recent no natural disasters campaign (Smith, 2006),

The challenge, recognised as a priority area for action in the Sendai Framework, is the need for improved understanding of disaster risk in all its dimensions of hazard, exposure, and vulnerability and to anticipate, plan for, and reduce risk to protect persons and communities (UNISDR, 2015). Schroeter et al propose a model of hazard, vulnerability and exposure intersection of impact effect (Figure 2) (Schroeter et al., 2021). Contextualising hazard, exposure and vulnerability components of an identified impact enables understanding of disaster risk and the creation of risk controls across the prevention, preparedness, response and recovery continuum.

Figure 2. Hazard, exposure, vulnerability and impact



(Schroeter et al., 2021)

Social disruption and a breakdown in community cohesion is commonly referred to as an outcome, rather than a cause of a disaster (Kreps, 2005). Societal disruption that generates health impacts upon communities is rarely considered or recognised as a disaster. Moreover, if such disruption is increasingly common within a community it is often not recognised as an emerging risk or disaster; or, if the disruption is returning, a re-emerging risk or disaster. Flage and Aven reported categorisation of societal risk as a core global emerging risk. Emerging global societal risks described include: pandemics and infectious diseases; chronic diseases in the developed world; greater economic inequality; breakdown of critical infrastructure; rapid shifts in demographic patterns; and unsustainable world population growth (Flage and Aven, 2015).

Disaster risk reduction is aimed at preventing new and reducing existing disaster risk and managing residual risk, all of which contribute to strengthening resilience and therefore to the achievement of sustainable development (UN, 2016). To fulfil its function there is a pressing need to recognise all possible disasters, so that they can be monitored, studied, and their associated risks and drivers reduced.

The impact of drug addiction, domestic violence and suicide upon human health and wellbeing can be associated with each of these disaster impact definitions. Exploration of these impacts through the lens of disaster risk management may inform practice to reduce risk and prevent harm.

Methods

We conducted a literature review to explore drug addiction, domestic violence and suicide as societal disruptions causing disaster. Key Australian government reports describing deaths associated with suicide, domestic violence and drug addiction were identified, following which a constrained snowball sampling was applied to the bibliography of each document to gather further key articles and inform the evolution of the impact of these themes in Australia over the period 2000 – 2018 (Lecy and Beatty, 2012). The search strategy included both peer reviewed and grey literature. We used the search terms 'social disruption', 'non-traditional', 'drug addiction', 'domestic violence', 'suicide' and 'societal disruption' as key words and included articles if they demonstrated an analysis of the theme related to health impact related to disaster settings.

Results

The Australian Bureau of Statistics publication, 'Causes of Death, Australia, 2016' defines drug induced death as one directly attributable to drug use (i.e. overdose), or where drugs played a contributory factor (COA, 2016). The report showed an increasing trend of harmful drug use and drug induced deaths over the last decade, measured at that time at 7.5 deaths per 100,000 Australians (ABS, 2017). This figure does not include the additional direct and indirect health, social and economic impact upon families and communities affected by drugs which is estimated to be significant and far reaching (Family and Services, 2007). The effect of drug addiction, a known social health determinant, disproportionately affects vulnerable persons and is recognised in Australia as a cause of poor health with significant social and economic impacts (AloHa, 2016, Collins and Lapsley, 2008). These effects are of equal and in some cases of greater impact than many commonly recognised natural and man-made hazards resulting in impacts classified as disasters. As such drug addiction meets norms of classification of both a driver of, and a cause of disaster risk.

The Family Law Act 1975 defines domestic violence as "*violent, threatening or other behaviour by a person that coerces or controls a member of the person's family, or causes the family member to be fearful*" (Seddon, 1993). Domestic homicide is defined by the 'Homicide in Australia 2012–13 to 2013–14 National Homicide Monitoring Program report' as: '*incidents involving the death of a family member or other person in a domestic relationship*' (Bryant and Bricknell, 2017). From 2012 to 2014, 200 deaths were caused by domestic violence in Australia (Bryant and Bricknell, 2017), representing an approximate death rate of 0.29 per 100,000 for this period. The effects of domestic violence, like the effects of disasters, extend beyond initial impact and result in long-term health consequences for those affected. Mishra and collaborators conducted a longitudinal study of women's health in Australia and showed that women who had experienced childhood sexual abuse were more likely to have poor health and depression compared with those who had not (Mishra and Byles, 2014). Similarly, research conducted by Ayre et al showed domestic violence to be the greatest cause of burden of disease for women aged 25–44 in 2011 (Ayre, 2016). Further to this, like the effects of commonly reported disasters, domestic violence results in population displacement and is a leading cause of homelessness for women with children. In 2016 over 100,000 men, women and children sought homelessness services reporting domestic violence as related factor (AIHW, 2019). Vulnerable populations are overrepresented in the impacts of domestic violence in Australia. Over 45% of hospitalisations caused by domestic violence involved people living in the lowest socioeconomic areas of Australia. Between 2017 and 2018 Indigenous Australians suffered more domestic violence than other Australians (Bricknell, 2019). In 2015–16, Indigenous children were 7 times as likely to be the subject of substantiated child abuse or neglect as non-Indigenous children (AIHW, 2019).

The 2010 report, 'The hidden toll, suicide in Australia' found that more than 2,000 Australians each year take their own lives; more than one in eight Australians have thought about taking their own life; 4% have made suicide plans and 3% have attempted suicide during their lifetime (CAO, 2010). Since this report the suicide rate in Australia has remained relatively unchanged with greater than 10 deaths per 100,000 people each year (WHO, 2015). A completed suicide is defined by the Australian Bureau of Statistics as '*a death due to unnatural causes, such as injury, poisoning or suffocation rather than an illness; the actions which result in death must be self-inflicted; and the person who injures himself or herself must have had the intention to die*'. Suicide is the leading cause of death among people 15-44 years of age and remains the

leading cause of premature mortality in Australia. In 2016, suicide deaths occurred at a rate of 11.7 deaths per 100,000 people and has consistently ranked in the top 20 causes of death in Australia for over a decade (McNamara, 2013).

The reported average death rate from any disaster in Australia per 100,000 persons by the World Health Organisation from 2012-2016 for disasters was 0.032 (WHO, 1999). Comparatively, all disasters recorded by the EM-DAT database from Australia for the period 2012-2016 (both years included) shows an average yearly death rate per 100,000 Australians as 0.23 (table 3).

Table 3. EMDAT Reported Disasters in Australia by Disaster type and death toll 2012-2016.

Disaster Type and Sub-type	Total Deaths
Natural	178
Convective storm	12
Flash flood	6
Forest fire	
Heat wave	139
Land fire (Brush, Bush, Pasture)	9
Riverine flood	4
Tropical cyclone	7
Viral disease	
(blank)	1
Technological	88
Water	88
Grand Total	266

(EM-DAT, 2021)

Using the EM-DAT database as a reference point for disaster death impacts during the same time period as per the effects of drug addiction, suicide and domestic violence (2007-2017) considered in this report, the average rate of death and total sum of death by all types of reported disasters in the same period is significantly less than the impacts of the societal hazards examined (table 4):

Table 4. EMDAT Reported Disasters in Australia by Disaster type and death toll 2007-2017.

Disaster type and sub-type	Total Deaths
Natural	781
Extreme temperature	486
Flood	69
Storm	37
Wildfire	189
Technological	182
Miscellaneous accident	10
Transport accident	172
Grand Total	963

(EM-DAT, 2021)

Utilising the Australian Disaster Resilience Knowledge Hub and the international CRED criteria for a disaster (table 1), the impact to human health of drug addiction, domestic violence and suicide upon the Australian population each meet the criteria of a disaster, particularly if considered as a 'diffuse disaster' (Ranson, 1993). Impacts of other, possible societal hazards not included in this review such as pollution, obesity and road accidents may well also fit the above criteria.

Discussion

One goal of the 2015 Sendai Framework for Disaster Risk Reduction 2015-2030 is to prevent new risks and reduce existing ones. Moreover, these goals include reducing vulnerabilities through actions addressing underlying disaster risk drivers including health determinants or consequences such as poverty, inequality, and marginalization (UNISDR, 2015). The Sendai Framework for Disaster Risk Reduction is a significant change in policy direction in respect to its precursor the Hyogo Framework, bringing a specific focus on health (Maini et al., 2017). This is evident by a shift in focus from disaster management to disaster risk identification, mitigation and management, and emphasis on social and health impacts and their prevention. This change represents an opportunity for improved understanding of identification, classification and measurement of disaster risk itself (UNISDR, 2015). Moreover the increased focus on health outcomes and health system strengthening within the framework showcases the need for a public health approach in managing disaster risk (Murray et al., 2015).

In Australia, disaster risk assessment is guided by the National Emergency Risk Assessment Guidelines (NERAG), the purpose of which is to guide hazard management and prioritize risk management activities (COA, 2010). This approach is congruent with the National Disaster Risk Reduction Framework and the objective of the Australian vulnerability profile to '*reduce new risks, avoid hazards turning into disasters, be capable and prepared*' (NDRRF, 2018).

When comparing the priorities for action of The Sendai Framework for Disaster Risk Reduction against the Australian National Strategy for Disaster Resilience and National Disaster Risk Reduction Framework it is notable that all identify 'understanding risk' as a key action (UNISDR, 2015, COAG, 2011, NDRRF, 2018).

Seeking to understand risk in all its forms implies broadening scope and encouraging new thinking to reset and test our current knowledge and classifications aiming to identify new and emerging risk and societal disruptions. Societal risk has been categorised as a core global emerging risk, and the World Health Organisation and the World Economic Forum include in their rankings and exercises pandemics and infectious diseases; chronic diseases in the developed world; greater economic inequality; breakdown of critical infrastructure; rapid shifts in demographic patterns; and unsustainable world population growth (Flage and Aven, 2015, GAR, 2017, WHO, 2007). These reports also suggest other subjacent risks such as unemployment or rapid migration patterns (GAR, 2017). The Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change by Cardona et al also found that social drivers were related to climate risk. Vulnerability and exposure are reported there as dynamic, varying across temporal and spatial scales, and dependent on economic, social, geographic, demographic, cultural, institutional, governance, and environmental factors (Cardona et al, 2012). Of note, this report described health determinants such as wealth, education, race/ethnicity/religion, gender, age, class/caste, disability, and health status as important causal factors of vulnerability. Whilst the described impacts in this paper have not hitherto been classified as disasters, consideration of them through a disaster risk reduction

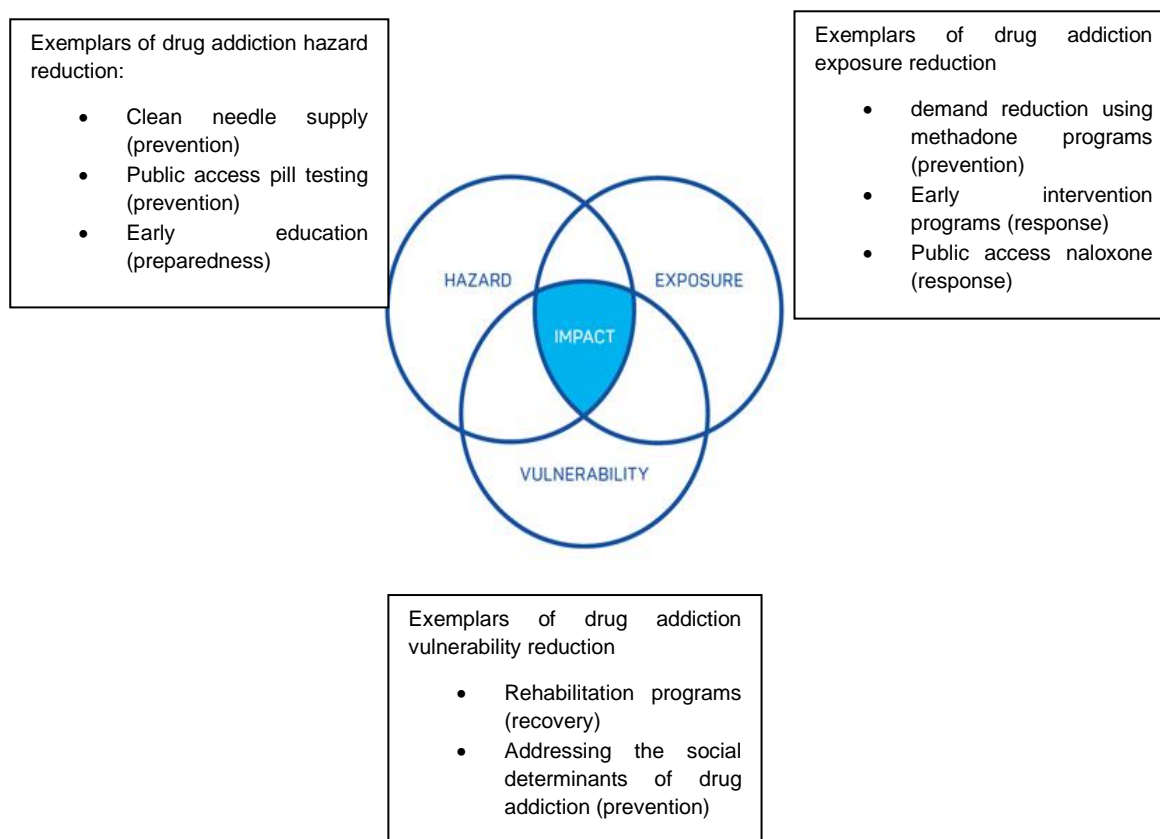
lens may be of benefit in understanding and addressing their impacts upon communities and in mitigating their consequences.

In keeping with traditional disaster types the impact of drug addiction and drug abuse disproportionately effects the most vulnerable. This impact is compounded in on agriculturally, production based, developing nations where international conventions and drug policies are frequently seen as unduly harsh and unduly favourable to developed, consumer countries (Csete et al., 2016).

The impact of suicide events has been previously described by Ranson as a 'Diffuse Disaster'; where it is temporally and spatially distributed in comparison to most other disasters. As a consequence, causal factors and impact assessment are only appreciated when the events are grouped together (Ranson, 1993). Identifying relationships of disaster hazards where spatial and temporal variation is present has previously been described as cascading interconnected risks (Gill and Malamud, 2016). Similarly, there is an opportunity to network interactions and changes in social vulnerability and improved identification and understanding of new hazards to improve mitigation and risk management activities.

Public health practice, as an evidence-based means of inquiry and action, can provide a guidance to systematically investigate the underlying causes of public health emergencies and disasters, and inform strategies to improve disaster risk reduction. The HEDRM Framework (WHO, 2019) provides a structure to contribute to addressing these social disruptions. Moreover, the addition of a disaster risk reduction lens to existing societal disruptions applied across the continuum of prevention, preparedness, response and recovery may enable new or additional countermeasures to reduce impact. An approach through addressing the social determinants of social disruptions such as drug addiction, domestic violence, suicide, informed by the literature, or, more broadly through the established social determinants of health (Wilkinson and Marmot, 2003), provides a rich paradigm to consider additional, complementary countermeasures. An example application of a disaster risk reduction lens using the hazard, exposure and vulnerability impact model proposed by Schroeter et al and incorporating public health interventions related to drug use and drug addiction is proposed in figure 3:

Figure 3. Exemplars of disaster risk reduction to drug addiction and drug use.



The application of contemporary disaster risk reduction thinking utilising such a model provides an opportunity to explore these, and additional phenomenon through a disaster risk reduction lens and consider additional countermeasures designed to reduce health impacts.

The impacts of drug addiction, domestic violence and suicide could be framed as disasters. A comprehensive approach to prevention, early intervention and treatment, which recognises the underlying drivers of these social disruptions should be implemented to reduce impacts. Such an approach needs to be adequately resourced and should contain a range of strategies aimed at building resilience, reducing hazards, vulnerability and exposure, and providing support to individuals, families and communities suffering the consequences from drug addiction, domestic violence and suicide. Evidence based programs that are effective in reducing harm to both the individual and the community should be supported while funding for interventions of doubtful effectiveness or those accompanied by severe adverse effects should be reviewed; and attention given to the impact on at risk populations. The application of public health tools including the Haddon matrix and associated countermeasures could be undertaken to inform and prioritise disaster risk mitigation activities.

Conclusion

The health impacts on victims of drug addiction, domestic violence and suicide, and the individual and cumulative health impacts upon the affected families and communities meets internationally recognised definitions of a disaster. The impact of drug addiction, domestic violence and suicide disproportionately affects vulnerable populations within communities. Public Health practice through the lens of the determinants of social disruption combined with activities that consider hazards, vulnerability and exposure, can institute prevention, preparedness, response, and recovery programs to reduce the impact of drug addiction, domestic violence and suicide.

References

- ARNOLD, J. L. 2005. The 2005 London bombings and the Haddon matrix. *Prehospital and disaster medicine*, 20, 278-281
- AUSTRALIAN BUREAU OF STATISTICS (ABS). 2017. 3303.0—Causes of death, Australia, 2016. *Australian Bureau of Statistics Canberra, Australia*.
- AUSTRALIAN DEPARTMENT OF HOME AFFAIRS. 2018. The National Disaster Risk Reduction Framework. [Online]. Available: <https://www.homeaffairs.gov.au/emergency/files/national-disaster-risk-reduction-framework.pdf> [Accessed 10.01.2021 2021].
- AUSTRALIAN INSTITUTE FOR DISASTER RESILIENCE. 2017. *Australian Disaster Resilience Knowledge Hub* [Online]. Available: <https://knowledge.aidr.org.au/> [Accessed 10.01.2021 2021].
- AUSTRALIAN INSTITUTE FOR DISASTER RESILIENCE. 2017. *Australian Disaster Resilience Knowledge Hub* [Online]. Available: <https://knowledge.aidr.org.au/> [Accessed 10.01.2021 2021].
- AUSTRALIAN INSTITUTE OF HEALTH AND WELFARE (AIHW) 2016. Australia's health 2016. vol. *Australia's health series*.
- AYRE, J., LUM ON, M., WEBSTER, K., GOURLEY, M., & MOON, L. 2016. Examination of the burden of disease of intimate partner violence against women in 2011: *Final report*. Sydney: ANROWS: ANROWS Horizons.
- BARNETT, D. J., BALICER, R. D., BLODGETT, D., FEWS, A. L., PARKER, C. L. & LINKS, J. M. 2005. The application of the Haddon matrix to public health readiness and response planning. *Environmental health perspectives*, 113, 561-566.
- BRICKNELL, S. 2019. Homicide in Australia 2015–16. *Statistical Reports*.
- BRYANT, W. & BRICKNELL, S. 2017. Statistical report 02.
- COLLINS, D. & LAPSLEY, H. M. 2008. The costs of tobacco, alcohol and illicit drug abuse to Australian society in 2004/05, *Department of Health and Ageing Canberra*.
- COMMONWEALTH OF AUSTRALIA (COA). 2010b. The hidden toll: suicide in Australia. *Canberra: Commonwealth of Australia*.
- COMMONWEALTH OF AUSTRALIA (COA). 2007. The winnable war on drugs: The impact of illicit drug use on families. *Parliament of the Commonwealth of Australia Canberra*.
- COUNCIL OF AUSTRALIAN GOVERNMENTS. 2011. National strategy for disaster resilience. *Commonwealth of Australia Barton*.
- CSETE, J., KAMARULZAMAN, A., KAZATCHKINE, M., ALTICE, F., BALICKI, M., BUXTON, J., CEPEDA, J., COMFORT, M., GOOSBY, E. & GOULÃO, J. 2016. Public health and international drug policy. *The Lancet*, 387, 1427-1480.
- EDDLESTON, M., BUCKLEY, N. A., GUNNELL, D., DAWSON, A. H. & KONRADSEN, F. 2006. Identification of strategies to prevent death after pesticide self-poisoning using a Haddon matrix. *Injury Prevention*, 12, 333-337.
- EMERGENCY EVENTS DATABASE (EM-DAT). The OFDA/CRED international disaster database. Available: <https://www.emdat.be/>. Accessed 10.01.2021 2021].
- FLAGE, R. & AVEN, T. 2015. Emerging risk—Conceptual definition and a relation to black swan type of events. *Reliability Engineering & System Safety*, 144, 61-67.
- GILL, J. C. & MALAMUD, B. D. 2016. Hazard interactions and interaction networks (cascades) within multi-hazard methodologies. *Earth System Dynamics*, 7, 659-679.
- GLOBAL RISKS ASSESSMENT REPORT. 2017. World Economic Forum, 2017.
- HUTTON, A., SAVAGE, C., RANSE, J., FINNELL, D. & KUB, J. 2015. The use of Haddon's matrix to plan for injury and illness prevention at outdoor music festivals. *Prehospital and disaster medicine*, 30, 175.
- KREPS, G. A. 2005. Disaster as systemic event and social catalyst. *What is a Disaster?* : Routledge.
- LECY, J. D. & BEATTY, K. E. 2012. Representative literature reviews using constrained snowball sampling and citation network analysis. Available at SSRN 1992601.
- MAINI, R., CLARKE, L., BLANCHARD, K. & MURRAY, V. 2017. The Sendai Framework for disaster risk reduction and its indicators—where does health fit in? *International Journal of Disaster Risk Science*, 8, 150-155.

- MCNAMARA, P. M. 2013. Adolescent suicide in Australia: rates, risk and resilience. *Clinical child psychology and psychiatry*, 18, 351-369.
- MISHRA, G. & BYLES, J. 2014. Australian Longitudinal Study on Women's Health. *The University of Queensland*.
- MORACCO, K. E., RUNYAN, C. W. & BUTTS, J. D. 1998. Femicide in North Carolina, 1991-1993: A statewide study of patterns and precursors. *Homicide Studies*, 2, 422-446.
- MURRAY, V., AITSI-SELM, A. & BLANCHARD, K. 2015. The role of public health within the United Nations post-2015 framework for disaster risk reduction. *International Journal of Disaster Risk Science*, 6, 28-37.
- NATIONAL EMERGENCY MANAGEMENT COMMITTEE (NEMC). 2010a. National Emergency Risk Assessment Guidelines. *Tasmanian State Emergency Service, Hobart*.
- RANSON, D. 1993. The role of the pathologist in homicide investigations and coronial inquiries. *Homicide : patterns, prevention and control*. Canberra. *Australian Institute of Criminology*.
- RUDD, K. 2008. The first national security statement to the Australian parliament. *public address given, December, 4*.
- RUNYAN, C. W. 2003. Introduction: back to the future—revisiting Haddon's conceptualization of injury epidemiology and prevention. *Epidemiologic reviews*, 25, 60-64.
- SCHROETER, S., RICHTER, H., ARTHUR, C., WILKE, D., DUNFORD, M., WEHNER, M. & EBERT, E. 2021. Forecasting the impacts of severe weather. *Australian Journal of Emergency Management*, 10.47389/36, 76-83.
- SEDDON, N. 1993. *Domestic Violence in Australia: the legal response*, Federation Press.
- SMITH, N., 2006. There's no such thing as a natural disaster. *Understanding Katrina: perspectives from the social sciences*, 11.
- UNISDR 2015. Sendai Framework for Disaster Risk Reduction 2015 - 2030. 9-11 Rue de Varembe CH 1202, Geneva Switzerland.
- UNITED NATIONS GENERAL ASSEMBLY (UN). 2016. Report of the open-ended intergovernmental expert working group on indicators and terminology relating to disaster risk reduction. *United Nations General Assembly: New York, NY, USA*, 41.
- WILKINSON, R. G. & MARMOT, M. 2003. Social determinants of health: the solid facts, *World Health Organization*.
- WORLD HEALTH ORGANIZATION 1999. *Global health observatory*.
- WORLD HEALTH ORGANIZATION. 2007. Risk reduction and emergency preparedness: WHO six-year strategy for the health sector and community capacity development, *Geneva, World Health Organization*.
- WORLD HEALTH ORGANIZATION. 2015. Suicide Rates, age standardized-Data by Country. URL: <http://apps.who.int/gho/data/node.main.MHSUICIDEASDR>.
- WORLD HEALTH ORGANIZATION. 2019. Health emergency and disaster risk management framework.
- ZHONG, S., CLARK, M., HOU, X.Y., ZANG, Y.L. AND FITZGERALD, G., 2013. 2010–2011 Queensland floods: Using Haddon's Matrix to define and categorise public safety strategies. *Emergency Medicine Australasia*, 25(4), pp.345-352.

6.4.3 Discussion

This paper provides a focussed analysis of the health impacts on victims of addiction, domestic violence and suicide, and how the health impacts meet internationally recognised definitions of a disaster. These findings contribute to this thesis by showing that the similarity between social health determinant impacts and disaster impacts have to date been largely unrecognised or recorded as such. Progress at an Australian level related to Domestic violence has been initiated. The Draft National Plan to End Violence against Women and Children 2022-2032 has been released for public feedback in January of 2022, the guiding frameworks of prevention, response and recovery described within it are congruent with the disaster risk management cycle.

6.5 STAGE 2 DISCUSSION

This stage has provided an exploration of Social determinants of Health as drivers of disaster or as actual hazards causing disaster. The discussion of research findings has been incorporated into the research outputs of this Stage and previous chapters. This chapter provides an overview of strengths and weaknesses of this stage.

6.5.1 Strengths

The strengths of the design and methods applied in the research projects undertaken in this PhD are the use of mixed methods to explore objectives and formulate recommendations and conclusions. Themes developed from participant engagement were compared to existing data related to the research aims to identify gaps in knowledge belief and/or practice.

6.5.2 Weaknesses including potential bias

Challenges noted during the research were associated with more information being found in the “grey literature” and in humanitarian practice than in peer reviewed literature. Variance in terminology of definitions, for example ‘resilience’ is used by a variety of academic fields in different contexts. Whilst Utstein guidelines for research and evaluation in disasters have been produced[112], definitions are applied inconsistently across disaster practice. The diversity of the disaster peer reviewed literature, as evidenced by a study conducted by Smith et al. identified nearly 2,000 peer reviewed, event specific publications that have been published in 789 journals[113].

Weaknesses associated with this research include limitations related to the scope of the projects (small country town). This limits the capacity to apply the results in broader contexts. Further, like research is required to allow comparison of results.

Weaknesses identified in publication of results associated with research project one included limited data related to Pacific respondents. Further data gathering and analysis was undertaken to address this and included in the thesis writings.

6.5.3 Reflections on Health and Disaster Risk Reduction

Public health practice, as an evidence-based means of inquiry and action, can provide a guidance to systematically investigate the underlying causes of public health emergencies and disasters, and inform strategies to improve disaster risk reduction. As a leader in harm and injury prevention Public health practice should be engaged in understanding the social environment and guide a comprehensive approach to prevention, early intervention and treatment, which recognises the underlying drivers of social problems. Such an approach needs to be adequately resourced and should contain a range of strategies aimed at building resilience, reducing vulnerability, and providing support to individuals, families and communities. To improve outcomes of the health impacts of disasters actions are required to reduce exposure to hazards, decrease vulnerability of people and property, improve management of land, the environment, and preparedness for adverse events.

6.6 STAGE 2 CONCLUSION

This stage investigated how the Social Determinants of Health may inform interventions to prevent, prepare, respond and recover from disasters and how characteristics of population health relate to, and impact upon disaster risk, resilience, vulnerability, impact and recovery. Key findings of this study demonstrated that strong social connection within the community provides knowledge and support that enhances disaster risk awareness and preparedness and improves an individual's disaster resilience. Conversely stress and social exclusion from the community was perceived to increase an individual's vulnerability to disaster. Disaster resilience was found to be a function of good physical and mental health; and effective disaster planning required community partnership in the development, education and testing, with robust communication as an essential trait of communication plans.

7. THESIS DISCUSSION

7.1 INTRODUCTION

Contemporary evidence recommends systematic effort to analyse and manage the causal factors of disasters, rather than using traditional management processes, to improve disaster risk reduction [10-12, 154]. This thesis answered the following research questions:

- What are the profiles of emerging disaster risks in Oceania?
- In what way do the Social Determinants of Health inform outcome indicators of disaster programs?
- How can disaster risk reduction interventions assume wider responsibility for creating healthy societies?

Broader examination of emerging disasters and non-traditional health threats is fundamental to understanding the health of communities and the vulnerabilities within them [118, 155] particularly in a rapidly changing and globalising world. Once exposed, the effects of disaster on vulnerable groups can be magnified, resulting in marginalisation and increased suffering. Vulnerability arises from social, cultural, health and environmental interactions [129]; as such no single agency is equipped to adequately respond to identified needs and a multi-disciplinary approach is required. Further examination of emerging disasters and non-traditional health threats is warranted. However, the challenge for the emergency management discipline is to examine this in more depth and re-evaluate contemporary practice [135]. This thesis found that thinking beyond traditional approaches of responding to natural hazards is required to understand the causal factors of disasters and community resilience and preparedness for adverse events. Improved understanding of the health of persons and the community they live and grow in is core to their resilience to threats. Robust (or lack thereof) determinants of health influence the outcomes of disaster events upon an individual and/or a community. This thesis provides guidance to inform and advance current practice through the incorporation of the Social Determinants of Health as a holistic approach to inform disaster risk reduction practices.

7.2 SUMMATION OF KEY FINDINGS OF THIS RESEARCH

Extensive discussion explored key findings of Stage one and Stage two at the end of each respective stage. This chapter summarises these findings linking them to the research questions. This study aimed to investigate how the Social Determinants of Health inform outcome indicators of disaster programs and how characteristics of population health relate to, and impact upon disaster risk, resilience, vulnerability, impact and recovery.

Non-traditional health threats and impacts causing societal disruption were a feature of our investigation. These emerging disaster risks in Oceania are not captured by traditional disaster definitions and classification methodology or in existing disaster databases.

This thesis demonstrated that strong social connection within the community provides knowledge and support that enhances disaster risk awareness and preparedness and improves an individual's disaster resilience. Conversely stress and social exclusion from the community was perceived to increase an individual's vulnerability to disaster. Disaster resilience was found to be a function of good physical and mental health; and effective disaster planning required community partnership in the development, education and testing, with robust communication as an essential trait of communication plans.

7.2.1 Key domains of disaster risk measurement

Measuring impacts from disasters enables planning, decision-making and policy development to address disaster risk. Accuracy and consistency of disaster recording utilising agreed definitions, measures and indicators is important to achieve robust data analysis and findings.

There are new, emerging threats that do not fit the existing, traditional disaster database classification. These threats, such as climate change have been described as aggravating factors that increase the frequency, complexity and severity of disasters. To improve sensitivity of detection, it is recommended that a review of disaster classification contextual to emerging threats to health is conducted, and a monitoring program is established to identify and track these drivers of risk. Action in this sphere is underway, the author led the development, drafting and publishing of the WADEM position statement on accurate reporting of public health information to contribute to international policy and guidance on reporting.

7.2.2 Key domains of community disaster risk management

Community strength and connectedness was a feature of this study that was considered as a factor that enhanced a community members resilience. This connectedness was perceived as a strength as it facilitated support between community members. When describing a disaster resilient community, a resident suggested:

'Capacity to bind people together to help each other for protection at the time and then help each other to return to normal as soon as possible'

Social connectedness has been previously explored by Lacoviello et al in reference to the impacts of disaster. Their findings showed that supportive social networks increase an individual's resilience, and importantly, enhancement of them pre disaster impact had a positive effect on mitigating psychological trauma post event [143].

7.2.3 Factors that support or hinder community disaster risk management

Provision of information featured strongly in this research. This is consistent with the research findings of Norris et al who describe elements of adaptive capacities of communities affected by disaster [141]. Norris also identified that the lack of information

created community stress, a finding consistent with a respondent in this research who reported that:

‘Being by yourself with no resources and without knowledge on what to do makes you vulnerable. A lack of information in the 2009 fires meant people were reacting to rumour and whispers of what was happening. You need a central point of communication, somewhere where the community can receive information and ask questions. Without this the community splits apart’

Maintaining trust and mitigating fracturing of communities during and after disasters is achieved by timely, factual communication from leadership [147, 148]

Significant barriers in accessing basic needs by older persons have also been reported which can exacerbate challenges faced by older persons in preparing and responding to disaster [146]. The interview respondents in this project consistently reported higher vulnerability of elderly residents in the community to disasters. Recent research investigating the impacts of Hurricane Katrina on older adults also found differences in risks in disasters compared to the community they reside in. Identified challenges included physical and psychological health barriers; and the inability to evacuate without assistance in preparation, transportation and pet care [149]. As noted by an interviewee:

‘Elderly due to lack of mobility, they have a greater dependency and need for transport and can become disconnected from the community’

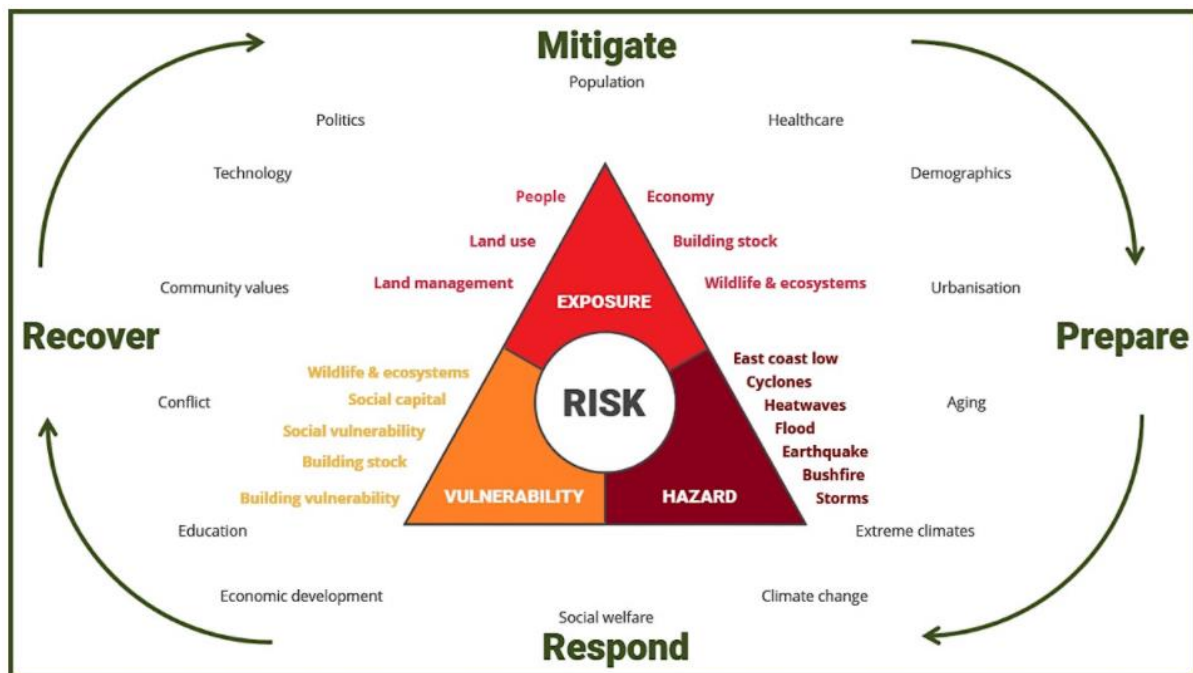
This report contributes to the evolving research base investigating older persons in disasters [150, 151]

This study found that social exclusion (where an individual experiences poverty, social exclusion, and/or discrimination) was considered to have a significant impact on an individual’s disaster resilience. This finding is consistent with research conducted by Norris et al who found that populations with low socio economic status are at greater risk of mental health consequences following a disaster, due to feelings of lack of self-worth and income stress [141]. A previously conducted literature review has identified lack of social support, female gender, prior traumas, resource loss, human loss and poor physical or mental health as likely indicators of psychological resilience to disasters [142]. The findings of this study are consistent with this literature review and serve to further exemplify the utilisation of Social Determinants of Health as indicators of community disaster resilience.

7.2.4 Key findings related to proposed research conceptual framework

The theoretical elements of health, climate change, sustainable development, disaster management, and governance of this thesis conceptual framework informed the research design. The conceptual framework unifying themes that guided investigation in stage one and two of this thesis were: emerging disaster risk, the Social Determinants of Health, and disaster risk reduction. The components of the conceptual framework developed for this thesis have since been described in a similar relationship by the Australian Royal Commission into National Natural Disaster Arrangements ‘Elements of disaster risk associated with natural hazards’ [6]

Figure 4: Royal Commission into National Natural Disaster Arrangements ‘Elements of disaster risk associated with natural hazards’.



[6]

Stage one and Stage two of this thesis explored the current status of how emerging disaster risk is captured and measured, and how health and disaster risk are related. This thesis investigated how the Social Determinants of Health inform outcome indicators of disaster programs and how characteristics of population health relate to, and impact upon disaster risk, resilience, vulnerability, impact and recovery. Key findings of this thesis demonstrated that strong social connection within the community provides knowledge and support that enhances disaster risk awareness and preparedness and improves an individual’s disaster resilience. Conversely stress and social exclusion from the community was perceived to increase an individual’s vulnerability to disaster. Disaster resilience was found to be a function of good physical and mental health; and effective disaster planning required community partnership in the development, education and testing, with robust communication as an essential trait of communication plans.

7.2.5 The value of population health related to disaster risk reduction

The relationship between disaster risk and health status is poorly understood. The Social Determinants of Health are defined as “the conditions in which people are born, grow, live, work and age, including the health system”[118]. As such when these determinants are not distributed equitably, poor health is a consequence. It is postulated that the differences in health status observed between populations are a result of uneven distribution of wealth, power and/or policy that influence these determinants. Like medicine, the historical focus of disaster practice has predominantly examined event response rather than event cause. Consideration of the Social Determinants of Health and how they relate to a population or

individuals' vulnerability to disaster is a novel method of understanding disaster risk and resilience.

7.3 IMPLICATIONS FOR FUTURE POLICY AND PRACTICE

Disaster risk reduction should be incorporated into all levels of community and population planning and development. The challenge required to achieve this are great as it requires long term political vision to enable policy and planning that increases health security at an individual, community and national level. Furthermore, if implemented these practices must be people centred. The provision of guidance, information, and access to services that incorporate and build on social norms and cultural practices will improve program integration and enable informed decision making by citizens.

The themes described in this research provide opportunity to inform, update and improve policy and practice. Action should be initiated to implement education and ownership of risk reduction practice at a person and community level. Facilitation and leadership at a government level is required to guide this process to achieve activities that are designed to mitigate impact and improve resilience.

Engagement in the research findings was achieved via development and publishing of peer reviewed papers, presentation at research forums, and contribution to global publications in this field.

7.4 IMPLICATIONS FOR FUTURE RESEARCH

This research has shown that there is a need for increased understanding of risk and forecasting of emerging threats. Community based risk assessment, improved understanding of health impacts and risk understanding and awareness in communities may be potential future Indicators of resilience.

The use of the Social Determinants of Health in this PhD to frame vulnerability was a unique feature of the project that is now becoming more mainstream in disaster risk reduction commentary. Helen Clark, former New Zealand Prime Minister and UNDP Administrator noted the linkage between poverty, human development and disaster impact. When comparing the 2010 earthquake in Haiti and 2011 earthquake in Christchurch, both of approximately the same magnitude but vastly different impacts. The loss of 185 lives in Christchurch compared with over 220,000 deaths in Haiti shows that the magnitude of the natural hazard alone that determines its impact [156]. Outcomes such as this show the importance of disaster risk reduction integration into economic and social development including planning, infrastructure, employment and livelihoods. Achieving such outcomes is consistent with actions in the Sendai Framework for Disaster risk Reduction of "the substantial reduction of disaster risk and losses in lives, livelihoods and health and in the

economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries” [26].

This linkage and integration have been reported as a new hazard type described within the United Nations Office for Disaster Risk Reduction and International Science Council Sendai Hazard Definition and Classification Review Technical Report. This updated report found that ‘Societal hazards’ are driven by the choices, behaviours and activities of humans and can result in disasters impacting the health status of populations as natural hazards do. This new, and emerging field was noted as requiring more research to inform understanding and scope to be considered under the Sendai Framework and a recommended area for future work [157]. This PhD has contributed to this emerging field with research on Societal Disruption accepted for publishing in the 2022 GAR report.

Further research is required across broader population groups to identify emerging risk and relationships between health determinants and disaster resilience. Achieving this will require review of disaster databases to comprehensively and consistently capture health impacts related to disaster impacts across existing and emerging threats.

7.5 IMPLICATIONS FOR COMMUNITIES

Recommendations developed from the research outputs of this project include:

1. Physical and mental health and wellbeing were viewed by the community as fundamental to a person’s disaster resilience. When planning is undertaken to improve a community’s disaster preparedness, the health status of the community should be assessed and incorporated into planning and programs.
2. Social inclusion (or lack thereof) was noted as a driver of vulnerability to disaster. Disaster plans and programs require actions to identify isolated community individuals and groups and seek to engage them in local disaster risk reduction.
3. Communication and community participation in disaster risk reduction planning enhances engagement, knowledge and local ownership of activities to reduce vulnerability and increase resilience. Planning and programs should be framed with a community participatory lens to achieve this outcome.

7.6 LIMITATIONS

Stage 1 of this PhD sought to understand the profiles of emerging disaster risks in Oceania and in the setting of capacity building and sustainable development how the Social Determinants of Health relate to emerging disaster risk. This study is limited in that there is not representation from all Oceanic Pacific Islands; additionally, the majority of respondents were predominantly employed in the health sector of disaster management. As a consequence, their views may be more focussed on health outcomes related to disaster

impacts based on insights that are related to practical experience in disaster management in Oceania. A predominantly Australian response rate (60%) was achieved compared to all other countries accesses in Oceania which may bias the perception of overall responses to be more Australian in perspective.

Stage 2 of this PhD sought to understand how the Social Determinants of Health inform outcome indicators of disaster programs. Variance in terminology definitions, for example the term 'resilience' is used with different meanings by a variety of academic fields in different contexts. Whilst Utstein guidelines for research and evaluation in disasters have been produced [112], definitions are still applied inconsistently across disaster practice. This study is limited by a lack of representation across all social demographic groups within the community.

Whilst SEIFA indices provide information of socio-economic advantage and disadvantage in a given area, their design was not developed relative to disaster risk reduction and/or vulnerability specific to emergency management planning or practice. Furthermore, SEIFA represents an average of all people living in an area and does not capture individual situations of people. Larger areas are more likely to have greater diversity of people and households" [158].

8. THESIS CONCLUSION

This thesis investigated the following problem statements:

Problem Statement 1:

Disasters continue to increase around the world in frequency, magnitude and societal cost. To advance the science and evidence-base of disaster risk improved forecasting of emerging disaster risk is required.

Problem Statement 1, sub statement 1:

Emerging disaster risks may not be associated with previous hazards, assessment of harm upon communities and whether it is contextualised as a disaster and doing so consideration of the application of disaster risk management to inform risk control is warranted.

Problem Statement 2:

The causal factors of health and how they relate to disaster vulnerability of a population is poorly understood.

This thesis found that emerging disaster risk and disaster impacts associated with health determinants are inconsistently measured and under reported. This thesis recommends that controls of current and future risks should be developed that are sensitive to human development and the environment, and contextual to the local population. To achieve this disaster risk management plans should be revised and enhance bottom-up approaches for risk management that develops and enables community action. Community based solutions are recommended for improving individual and community risk education, awareness, and ownership. Community and governmental trust is required to facilitate such action and empower communities to engage in prevention related strategies that are contextual to their location, capacities and vulnerabilities.

BIBLIOGRAPHY

1. Bradt, D.A., et al., *Professionalization of disaster medicine--an appraisal of criterion-referenced qualifications*. Prehospital & Disaster Medicine, 2007. **22**(5): p. 360-8.
2. Burstein, J.L. and J.L. Burstein, *The myths of disaster education*. [see comment][comment]. Annals of Emergency Medicine, 2006. **47**(1): p. 50-2.
3. Bradt, D.A., et al., *Rapid epidemiological assessment of health status in displaced populations--an evolution toward standardized minimum, essential data sets*. [republished in Prehosp Disaster Med. 2003 Jan-Mar;18(1):178-85; PMID: 14694899]. Prehospital & Disaster Medicine, 2002. **17**(4): p. 178-85.
4. Noji, E.K., *Disaster epidemiology: challenges for public health action*. Journal of Public Health Policy, 1992. **13**(3): p. 332-40.
5. World Health Organization, *Risk Reduction and emergency preparedness. WHO six year strategy for the health sector and community capacity development*. 2007.
6. World Health Organization, *Health emergency and disaster risk management framework*. 2019.
7. Lo., et al., *Health emergency and disaster risk management (Health-EDRM): developing the research field within the Sendai framework paradigm*. International journal of disaster risk science, 2017. **8**(2): p. 145-149.
8. AM, M.R.M., et al., *Royal Commission into National Natural Disaster Arrangements* 2020.
9. Council of Australian Governments, *National strategy for disaster resilience*. 2011, Commonwealth of Australia Barton.
10. Auf der Heide, E. and E. Auf der Heide, *The importance of evidence-based disaster planning*. [see comment]. Annals of Emergency Medicine, 2006. **47**(1): p. 34-49.
11. Burkle, F.M., *Lessons learnt and future expectations of complex emergencies*. BMJ, 1999. **319**(7207): p. 422-6.
12. Burkle, F.M., Jr., *The changing face of disaster management: implications for healthcare providers in the Pacific Islands*. Pacific Health Dialog, 2002. **9**(1): p. 55-7.
13. Marmot, M., et al., *Build back fairer: the COVID-19 Marmot review*. The pandemic, socioeconomic and health inequalities in England, 2020.
14. Arnold, J.L., *Disaster medicine in the 21st century: future hazards, vulnerabilities, and risk*. Prehospital & Disaster Medicine, 2002. **17**(1): p. 3-11.
15. Intergovernmental Panel on Climate Change, *Managing the risks of extreme events and disasters to advance climate change adaption: special report of the Intergovernmental Panel on Climate Change*. 2012, Cambridge University press: Cambridge. p. 582.
16. Burkle, J.F.M., *Future humanitarian crises: challenges for practice, policy, and public health*. Prehospital and disaster medicine, 2010. **25**(3): p. 191.
17. Palliyaguru, R., D. Amaratunga, and D. Baldry, *Constructing a holistic approach to disaster risk reduction: the significance of focusing on vulnerability reduction*. Disasters, 2014. **38**(1): p. 45-61.
18. Lavell, A. and A. Maskrey, *The future of disaster risk management*. Environmental Hazards, 2014. **13**(4): p. 267-280.
19. UNISDR, W., *Disaster risk and resilience*. Thematic Think Piece, UN System Task Force on the Post-2015 UN Development Agenda, 2012.

20. Christoplos, I., J. Mitchell, and A. Liljelund, *Re-framing risk: the changing context of disaster mitigation and preparedness*. Disasters, 2001. **25**(3): p. 185-98.
21. Birkmann, J.r. and Ebrary, *Measuring vulnerability to natural hazards: towards disaster resilient societies*. 2006, New York: United Nations University Press.
22. Worl Health Organization, *Definition of health*. <http://www.who.int/suggestions/faq/zh/index.html>, 1948.
23. United Nations General Assembly, *Report of the world commission on environment and development: Our common future*. United Nations, 1987.
24. Rennie, H., *Global Platform on Disaster Risk Reduction 2013, Geneva, 19-23 May*. Lincoln Planning Review, 2013. **5**(1-2): p. 64-66.
25. ISDR, *UNISDR terminology on disaster risk reduction*. Geneva, Switzerland, May, 2009.
26. UNISDR, *Sendai Framework for Disaster Risk Reduction 2015 - 2030*. 2015: 9-11 Rue de Varembe CH 1202, Geneva Switzerland.
27. UNISDR, C., *The human cost of natural disasters: A global perspective*. 2015.
28. Nemeth, D.G. and T.W. Olivier, *Innovative approaches to individual and community resilience: from theory to practice*. 2017: Academic Press.
29. Australian Social and Inclusion Board, *Social inclusion in Australia: How Australia is faring*. 2012: Department of the Prime Minister and Cabinet.
30. Mayunga, J.S., *Understanding and applying the concept of community disaster resilience: a capital-based approach*. Summer academy for social vulnerability and resilience building, 2007. **1**(1): p. 1-16.
31. City Resilience Index, *City resilience framework*. The Rockefeller Foundation and ARUP, 2014.
32. Plodinec, M.J., *Definitions of resilience: An analysis*. Oak Ridge: Community and Regional Resilience Institute (CARRI), 2009.
33. Patel, S.S., et al., *What do we mean by 'community resilience'? A systematic literature review of how it is defined in the literature*. PLoS currents, 2017. **9**.
34. Garlick, D., *The vulnerable people in emergencies policy: Hiding vulnerable people in plain sight*. Australian Journal of Emergency Management, The, 2015. **30**(1): p. 31.
35. Goode, N., et al., *Review of recent Australian disaster inquiries*. 2011.
36. Bi, P., et al., *Effect of climate change on Australian rural and remote regions: what do we know and what do we need to know?[see comment]*. Australian Journal of Rural Health, 2008. **16**(1): p. 2-4.
37. McFarlane, A.C., et al., *After the fires: looking to the future using the lessons from the past*. Medical Journal of Australia, 2009. **190**(6): p. 291-2.
38. Wilkinson, P., *Climate change & health: the case for sustainable development*. Medicine, Conflict & Survival, 2008. **24 Suppl 1**: p. S26-35.
39. Productivity Commission, *Natural Disaster Funding Arrangements, Inquiry Report no. 74*, P. Commission, Editor. 2014: Canberra.
40. Attorney General Department, *Australian Government response to the Productivity Commission Inquiry into Natural Disaster Funding Arrangements*, A.-G.s. Department, Editor. 2016: Canberra.
41. Global Risks. *The Global Risks Report 2017*. in *World Economic Forum*. 2017.
42. *The National Disaster Risk Reduction Framework*, D.o.H. Affairs, Editor. 2018: Canberra.

43. Wilkinson, R.G. and M. Marmot, *Social determinants of health: the solid facts*. 2003: World Health Organization.
44. Marmot, M., et al., *Closing the gap in a generation: health equity through action on the social determinants of health*. The Lancet, 2008. **372**(9650): p. 1661-1669.
45. World Health Organization. *Rio political declaration on social determinants of health*. in *World Conference on Social Determinants of Health*. 2011. World Health Organization Rio de Janeiro.
46. United Nations General Assembly, *The 2030 Agenda for Sustainable Development*. 2015, Resolution A/RES/70/1.
47. Murray, V., A. Aitsi-Selmi, and K. Blanchard, *The role of public health within the United Nations post-2015 framework for disaster risk reduction*. International Journal of Disaster Risk Science, 2015. **6**(1): p. 28-37.
48. Kelman, I., *Linking disaster risk reduction, climate change, and the sustainable development goals*. Disaster Prevention and Management: An International Journal, 2017. **26**(3): p. 254-258.
49. Whitmee, S., et al., *Safeguarding human health in the Anthropocene epoch: report of The Rockefeller Foundation–Lancet Commission on planetary health*. The Lancet, 2015. **386**(10007): p. 1973-2028.
50. UN, *Disaster Risk Reduction and Sustainable Development*. 2014: Seventh Session of the UN General Assembly Open Working Group on Sustainable Development Goals.
51. Colglazier, W., *Sustainable development agenda: 2030*. Science, 2015. **349**(6252): p. 1048-1050.
52. UNESCAP, *Asia and the Pacific SDG Progress Report 2020*. 2020.
53. Pokharel, S., et al., *Global consensus frameworks, standards, guidelines, and tools: their implications in international development policy and practice*. Prehospital and disaster medicine, 2019. **34**(6): p. 644-652.
54. Archer, F., et al., *Analysis of Disaster Related International Consensus Frameworks 2015-2017: Implications for WADeM*. Prehospital and Disaster Medicine, 2019. **34**(s1): p. s77-s77.
55. UNDRR, *Strategic approach to capacity development for implementation of the Sendai framework for disaster risk reduction—A vision of risk-informed sustainable development by 2030. Concise Guide*. United Nations Office for Disaster Risk Reduction (UNDRR). 2018, UNDRR Geneva.
56. World Health Organization, *WHO Consultation on support to countries for action on the Social Determinants of Health*. 2008.
57. The Sphere Project, *Humanitarian Charter and Minimum Standards in Disaster Response*. 2004.
58. United Nations Office for Disaster Risk Reduction, *Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters*. 2005: Geneva.
59. The Intergovernmental Panel on Climate Change, *Agreed reference material for the IPCC fifth assessment report*, T.I.P.o.C. Change, Editor. 2014.
60. McAneney, J., et al., *100-years of Australian bushfire property losses: is the risk significant and is it increasing?* Journal of Environmental Management, 2009. **90**(8): p. 2819-22.
61. Rudd, K., *The first National Security Statement to the Australian Parliament*, T.G.o. Australia, Editor. 2008.

62. Noji, E.K., *The public health consequences of disasters*. Prehospital & Disaster Medicine, 2000. **15**(4): p. 147-57.
63. The Red Cross and Red Crescent, *Declaration Agenda for Humanitarian Action Resolutions*,. 2003: Geneva.
64. Victorian Government, *Victorian Emergency management reform white paper*, , P.a. Cabinet, Editor. 2012: Victoria.
65. World Health Organisation, *Constitution of The World Health Organisation*. 2006.
66. United Nations, *Report of the World Commission on Environment and Development*, G. Assembly, Editor. 11 December 1987.
67. United Nations, *Report of the World Summit on Sustainable Development*, G. Assembly, Editor. 2002.
68. United Nations General Assembly, *United Nations Millennium Declaration*. 2000.
69. Hulley, S.B., *Designing clinical research*. 2007: Lippincott Williams & Wilkins.
70. Patino, C.M. and J.C. Ferreira, *Inclusion and exclusion criteria in research studies: definitions and why they matter*. Jornal brasileiro de pneumologia : publicacao oficial da Sociedade Brasileira de Pneumologia e Tisiologia, 2018. **44**(2): p. 84-84.
71. Braun, V. and V. Clarke, *Using thematic analysis in psychology*. Qualitative research in psychology, 2006. **3**(2): p. 77-101.
72. Universities Australia, *Australian code for the responsible conduct of research*. 2018: National Health and Medical Research Council.
73. UNISDR, *Towards the Post -2015 Framework for Disaster Risk Reduction, considerations on its possible elements and characteristics*, T.U.N.O.f.D.R. Reduction, Editor. 2013.
74. Walker, P., *How to think about the future: history, climate change, and conflict*. Prehospital and disaster medicine, 2009. **24 Suppl 2**: p. s244.
75. Guha-Sapir, D., R. Below, and P. Hoyois, *EM-DAT: the CRED/OFDA international disaster database*. 2016.
76. IRDR, *Peril Classification and Hazard Glossary*. 2014, DATA Project Report.
77. United Nations General Assembly, *Report of the open-ended intergovernmental expert working group on indicators and terminology relating to disaster risk reduction*. United Nations General Assembly: New York, NY, USA, 2016. **41**.
78. Cuthbertson, J. *Emergencies of Scarcity and fresh water*: . 2018; Available from: <https://resilientlandscapes.blog/2018/04/08/emergencies-of-scarcity-and-fresh-water/>.
79. Cuthbertson, J., et al., *Non-traditional health threats: Redefining the emergency management landscape*. Australian Journal of Emergency Management, The, 2017. **32**(3): p. 40.
80. Bedford, R. and C. Bedford, *International migration and climate change: a post-Copenhagen perspective on options for Kiribati and Tuvalu*. Climate change and migration: South Pacific perspectives, 2010. **89**.
81. Jr, B.F., *Global Health in Developed Countries or Global Public Health by Another Name*, in *The University of Hawaii Department of Public Health Sciences, East-West Center*. 2017: Honolulu, Hawaii.
82. Bearne, A.D.A., *The Future of Historic Districts: A Model For Protecting Our Past From Climate Change*. 2016.
83. Kelman, I., *Climate change and the Sendai framework for disaster risk reduction*. International Journal of Disaster Risk Science, 2015. **6**(2): p. 117-127.

84. Srinivas, H. and Y. Nakagawa, *Environmental implications for disaster preparedness: lessons learnt from the Indian Ocean Tsunami*. Journal of environmental management, 2008. **89**(1): p. 4-13.
85. AIDR. *Australian Disaster Resilience Knowledge Hub* 2017 [cited 2021 10.01.2021]; Available from: <https://knowledge.aidr.org.au/>.
86. Scientific, C., *State of the climate 2020*.
87. Oberthür, S. and H.E. Ott, *Preamble and Definitions (Article 1)*, in *The Kyoto Protocol*. 1999, Springer. p. 99-101.
88. Solomon, S., et al., *IPCC fourth assessment report (AR4)*. Climate change, 2007. **374**.
89. Bernstein, L., et al., *IPCC, 2007: climate change 2007: synthesis report*. 2008, IPCC.
90. Parry, M., et al., *IPCC Fourth Assessment Report: Working Group II Report" Impacts, Adaptation and Vulnerability*. 2007, Cambridge University Press.
91. Wisner, B., et al., *At risk: natural hazards, people's vulnerability and disasters*. 2004: Psychology Press.
92. Cuthbertson, J., et al., *Current and Emerging Disaster Risks Perceptions in Oceania: Key Stakeholders Recommendations for Disaster Management and Resilience Building*. International journal of environmental research and public health, 2019. **16**(3): p. 460.
93. Lee, D., H. Zhang, and C. Nguyen, *The Economic Impact of Natural Disasters in Pacific Island Countries: Adaptation and Preparedness*. 2018: International Monetary Fund.
94. Vinke, K., et al., *A Region at Risk: The Human Dimensions of Climate Change in Asia and the Pacific*. 2017.
95. Adger, W.N., *Social and ecological resilience: are they related?* Progress in human geography, 2000. **24**(3): p. 347-364.
96. Levy, B.S. and J.A. Patz, *Climate change, human rights, and social justice*. Annals of global health, 2015. **81**(3): p. 310-322.
97. Cook, A.D. and C. Chen, *Disaster Governance in the Southwest Pacific: Perspectives, Challenges, and Future Pathways for ASEAN*. 2019.
98. Watts, N., et al., *The Lancet Countdown: tracking progress on health and climate change*. The Lancet, 2017. **389**(10074): p. 1151-1164.
99. Watts, N., et al., *The 2018 report of the Lancet Countdown on health and climate change: shaping the health of nations for centuries to come*. The Lancet, 2018. **392**(10163): p. 2479-2514.
100. Aitsi-Selmi, A. and V. Murray, *The Sendai framework: disaster risk reduction through a health lens*. 2015, SciELO Public Health.
101. World Health Organization, *Operational framework for building climate resilient health systems*. 2015: World Health Organization.
102. Intergovernmental Panel on Climate Change, *Impacts, adaptation, and vulnerability. part B: regional aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge, United Kingdom and New York, 2014.
103. *WADDEM Climate Change Position Statement*. Prehosp Disaster Med, 2017. **32**(4): p. 351.
104. Kasai, T., *For the future: delivering better health in the Western Pacific region*. Journal of Global Health Science, 2019. **1**.
105. Commonwealth of Australia, *National climate resilience and adaptation strategy*. 2015, Commonwealth of Australia Canberra.

106. World Health Organization. *Protecting the health of vulnerable people from the humanitarian consequences of climate change and climate related disasters*. in 6th session of the Ad Hoc Working Group on Long-Term Cooperative Action under the Convention (AWG-LCA 6). 2009.
107. Costello, A., et al., *Managing the health effects of climate change*. The Lancet, 2009. **373**(9676): p. 1693-1733.
108. Watts, N., et al., *Health and climate change: policy responses to protect public health*. The Lancet. **386**(10006): p. 1861-1914.
109. Ward, P.J., et al., *Aqueduct Floods Methodology*. 2020.
110. Paris Agreement, *United Nations Framework Convention on Climate Change, Paris Agreement*. 2015.
111. Weir, T. and Z. Virani, *Three linked risks for development in the Pacific Islands: Climate change, disasters and conflict*. Climate and Development, 2011. **3**(3): p. 193-208.
112. Knut Ole Sundnes, M.L.B., *Health Disaster Management Guidelines for evaluation and research in the Utstein style*. Vol. 17. 2003: Prehospital & Disaster Medicine
113. Smith, E., et al., *Three Decades of Disasters: A Review of Disaster-Specific Literature from 1977–2009*. Prehospital and Disaster Medicine, 2009. **24**(04): p. 306-311.
114. Commonwealth of Australia, *Royal Commission into National Natural Disaster Arrangements Report*. 2020, Royal Commission into National Natural Disaster Arrangements Canberra.
115. Desa, U., *Transforming our world: The 2030 agenda for sustainable development*. 2016.
116. Nomura, S., et al., *Social determinants of mid-to long-term disaster impacts on health: A systematic review*. International journal of disaster risk reduction, 2016. **16**: p. 53-67.
117. Twigg, J., *Disaster risk reduction: mitigation and preparedness in development and emergency programming*. 2004, Overseas Development Institute (ODI).
118. Marmot, M., *Social determinants of health inequalities*. The Lancet, 2005. **365**(9464): p. 1099-1104.
119. Hallegatte, S., et al., *Unbreakable: Building the Resilience of the Poor in the Face of Natural Disasters, Climate Change and Development*, Washington, DC: World Bank. 2017.
120. Naser-Hall, E., *The disposable class: Ensuring poverty consciousness in natural disaster preparedness*. DePaul J. Soc. Just., 2013. **7**: p. 55.
121. Winsemius, H.C., et al., *Disaster risk, climate change, and poverty: assessing the global exposure of poor people to floods and droughts*. 2015, The World Bank.
122. Adger, W.N., *Vulnerability*. Global Environmental Change, 2006. **16**(3): p. 268-281.
123. Adger, W.N., et al., *Social-ecological resilience to coastal disasters*. Science, 2005. **309**(5737): p. 1036-9.
124. Gallopín, G.C., *Linkages between vulnerability, resilience, and adaptive capacity*. Global Environmental Change, 2006. **16**(3): p. 293-303.
125. Manyena, S.B. and S.B. Manyena, *The concept of resilience revisited*. Disasters, 2006. **30**(4): p. 433-50.

126. Norris, F.H., et al., *Community resilience as a metaphor, theory, set of capacities, and strategy for disaster readiness*. American Journal of Community Psychology, 2008. **41**(1-2): p. 127-50.
127. Cutter, S.L., et al., *A place-based model for understanding community resilience to natural disasters*. Global Environmental Change, 2008. **18**(4): p. 598-606.
128. Bihari, M. and R. Ryan, *Influence of social capital on community preparedness for wildfires*. Landscape and Urban Planning, 2012. **106**(3): p. 253-261.
129. Lindsay, J., *The Determinants of Disaster Vulnerability: Achieving Sustainable Mitigation through Population Health*. Journal of the International Society for the Prevention and Mitigation of Natural Hazards, 2003. **28**(2): p. 291-304.
130. Plough, A., et al., *Building community disaster resilience: perspectives from a large urban county department of public health*. American journal of public health, 2013. **103**(7): p. 1190-1197.
131. Leaning, J., *Disasters and humanitarian crises: A joint future for responders?* Prehospital and disaster medicine, 2008. **23**(4): p. 291-294.
132. Arnold, J.L. and J.L. Arnold, *Risk and risk assessment in health emergency management*. Prehospital & Disaster Medicine, 2005. **20**(3): p. 143-54.
133. Sameroff, A.J. and K.L. Rosenblum, *Psychosocial Constraints on the Development of Resilience*. Annals of the New York Academy of Sciences. **1094**(1): p. 116-124.
134. Prior, T. and C. Eriksen, *Wildfire preparedness, community cohesion and social-ecological systems*. Global Environmental Change, 2013. **23**(6): p. 1575.
135. Paul, A.B. and K. Raisa, *Integration of Social Determinants of Community Preparedness and Resiliency in 21st Century Emergency Management Planning*. Homeland Security Affairs U6, 2012. **8**(1).
136. Labonté, R. and T. Schrecker, *Globalization and social determinants of health: Introduction and methodological background (part 1 of 3)*. Globalization and Health, 2007. **3**: p. 5-5.
137. Bradt, D.A., et al., *A strategic plan for disaster medicine in Australasia*. Emergency Medicine (Fremantle, W A), 2003. **15**(3): p. 271-82.
138. World Health Organization, *Health 2020 policy framework and strategy*, R.C.f. Europe, Editor. 2012.
139. Australian Bureau of Statistics, *Socio-economic indexes for areas (SEIFA)*. Canberra, 2011: p. 2013.
140. Australian Bureau of Statistics, *3303.0—Causes of death, Australia, 2016*. 2017, Australian Bureau of Statistics Canberra, Australia.
141. Norris, F.H. and S.P. Stevens, *Community resilience and the principles of mass trauma intervention*. Psychiatry: Interpersonal and Biological Processes, 2007. **70**(4): p. 320-328.
142. Rodriguez-Llanes, J.M., F. Vos, and D. Guha-Sapir, *Measuring psychological resilience to disasters: are evidence-based indicators an achievable goal?* Environmental Health, 2013. **12**(1): p. 115.
143. Iacoviello, B.M. and D.S. Charney, *Psychosocial facets of resilience: implications for preventing posttrauma psychopathology, treating trauma survivors, and enhancing community resilience*. European journal of psychotraumatology, 2014. **5**(1): p. 23970.
144. Bouma, G., *Australian soul: Religion and spirituality in the 21st century*. 2006: Cambridge University Press.

145. Ekanayake, S., et al., *"We lost all we had in a second": coping with grief and loss after a natural disaster*. World Psychiatry, 2013. **12**(1): p. 69-75.
146. Henderson, T.L., K.A. Roberto, and Y. Kamo, *Older adults' responses to Hurricane Katrina: daily hassles and coping strategies*. Journal of Applied Gerontology, 2010. **29**(1): p. 48-69.
147. Chandra, A., et al., *Getting actionable about community resilience: The Los Angeles county community disaster resilience project*. American journal of public health, 2013. **103**(7): p. 1181-1189.
148. Vernberg, E.M., et al., *Positive psychology and disaster mental health: strategies for working with children and adolescents*. Journal of clinical psychology, 2016. **72**(12): p. 1333-1347.
149. Rosenkoetter, M.M., et al., *Perceptions of older adults regarding evacuation in the event of a natural disaster*. Public Health Nursing, 2007. **24**(2): p. 160-168.
150. Campbell, J., *Introduction Applying the 'Disaster Lens' to Older Adults*. Generations, 2007. **31**(4): p. 5-7.
151. Gibson, M.J. and M. Hayunga, *We can do better: lessons learned for protecting older persons in disasters*. 2006.
152. Australian Business Roundtable, *Building Our Nation's Resilience to Natural Disasters, report for the Australian Business Roundtable for Disaster Resilience and Safer Communities*. Sydney, Australia, 2013.
153. Swanström, N. *Traditional and Non-Traditional Security Threats in Central Asia: Connecting the New and the Old*. in *China & Eurasia Forum Quarterly*. 2010.
154. Council of Australian Governments, *National Strategy for Disaster Resilience*. 2011.
155. Keleher, H. and C. MacDougall, *Understanding health: a determinants approach*. 2009, South Melbourne, Vic: Oxford University Press.
156. Clark, H. and U. Administrator, *Building Resilience: The Importance of Prioritising Disaster Risk Reduction: A United Nations Development Programme Perspective*. Lecture presented at the annual Hopkins Lecture, University of Canterbury, Christchurch, New Zealand, August, 2012. **15**.
157. Murray, V., et al., *Hazard Information Profiles: Supplement to UNDRR-ISC Hazard Definition & Classification Review*, in *UNDRR-ISC Hazard Definition & Classification Review: Technical Report: Geneva, Switzerland, United Nations Office for Disaster Risk Reduction; Paris, France, International Science Council*. 2020, UNDDR.
158. Pink, B., *Information paper: an introduction to socio-economic indexes for areas (SEIFA), 2006*. Canberra: Australian Bureau of Statistics (ABS), 2008.
159. World Health Organization, *International Health Regulations (2005)*. 2008: World Health Organization.
160. DOC, I., *Global health security-epidemic alert and response*. 2001.
161. Burkle, F.M., *Global health security demands a strong international health regulations treaty and leadership from a highly resourced World Health Organization*. Disaster medicine and public health preparedness, 2015. **9**(5): p. 568-580.
162. Cuthbertson, J., *Climate change as an emerging disaster risk in Australia and Oceania*. AFAC19 powered by INTERSCHUTZ Extended abstracts from the Bushfire and Natural Hazards CRC Research Forum (non-peer reviewed) Australian Journal of Emergency Management, Monograph No. 5, 2019.

APPENDICES

APPENDIX A: STAGE 1 - ETHICS DOCUMENTATION

Explanatory statement



EXPLANATORY STATEMENT

'Disaster Risk and the Social Determinants of Health – Profiling emerging risk in Oceania'

Project: 'Disaster Risk and the Social Determinants of Health – Profiling emerging risk in Oceania'

Chief Investigator: Emeritus Professor Frank Archer **Student: Joseph Cuthbertson**
Department: Monash University Disaster Resilience Initiative Phone : +61 456 635 172
Phone: + 61 3 9905 1388 Email : jlcut3@student.monash.edu
Email : francis.archer@monash.edu

You are invited to take part in this study, which is titled: 'Disaster Risk and the Social Determinants of Health – Profiling emerging risk in Oceania'. Please read this Explanatory Statement in full before deciding whether or not to participate in this research. If you would like further information regarding any aspect of this project, you are encouraged to contact the researchers via the phone numbers or email addresses listed above.

What does the research involve?

The aim of the study is to investigate non-traditional threats to the health and wellbeing of societies associated with disaster impact. Emerging disaster risks are poorly understood. Without clear evidence readiness to accept future threats is low resulting in delayed strategic planning for adaptation or response. The role of the analysis is to examine what emerging disaster risk evidence exists to support decision making and profile the nature, type and potential human and economic impact of emerging disaster risk.

Participants will be contacted via Skype at a time that is convenient for you and will participate in a one-on-one semi structured interview which will be audio recorded.

Why were you chosen for this research?

You were chosen for this research based on your experience in the fields of Disaster Medicine, Disaster Management, Emergency Management or the humanitarian arena based in Oceania.

Source of funding

There is no funding for this project.

Consenting to participate in the project and withdrawing from the research

Please read and sign the consent form. The form can be returned either by fax or scanned and emailed back. You have the right to withdraw from further participation at any stage. It may not be possible to withdraw the data once the responses have been submitted.

Possible benefits and risks to participants

There is no expectation of any physical/psychological stress, inconvenience or discomfort with the interview process.

Confidentiality

Your responses will remain anonymous and only the researchers will have access to the original data.

Storage of data

Data will be retained for five years in a private office with security and in a locked filing cabinet that only the researcher will have access to.

Use of data for other purposes

The data provided may be used by the researchers in future projects including, but not limited to: PhD thesis, journal article/book/chapter, conference presentation, online web based and oral presentation. Only aggregate de-identified data will be used for other projects where ethics approval has been granted.

Results

Participants can contact the researchers and request a summary of the findings.

Complaints

Should you have any concerns or complaints about the conduct of the project, you are welcome to contact the

Executive Officer, Monash University Human Research Ethics (MUHREC):

Executive Officer

Monash University Human Research Ethics Committee (MUHREC)

Room 111, Building 3e

Research Office

Monash University VIC 3800

Tel : +61 3 9905 2052
3831

Email : muhrec@monash.edu

Fax : +61 3 9905

Thank you,

Chief Investigator's signature:

Chief Investigator's name: Emeritus Professor Frank Archer

Consent form



MONASH University

CONSENT FORM

‘Disaster Risk and the Social Determinants of Health – Profiling emerging risk in Oceania’

Project: ‘Disaster Risk and the Social Determinants of Health – Profiling emerging risk in Oceania’

Chief Investigator: Emeritus Professor Frank Archer
Department: Monash University Disaster Resilience Initiative
Phone: + 61 3 9905 1388
Email : francis.archer@monash.edu

Student: Joseph Cuthbertson
Phone : +61 456 635 172
Email : jlcut3@student.monash.edu

I have been asked to take part in the Monash University research project specified above. I have read and understood the Explanatory Statement and I hereby consent to participate in this project.

I consent to the following:	Yes	No
Taking part in a Skype/telephone interview, OR	<input type="checkbox"/>	<input type="checkbox"/>
Completing the questions electronically	<input type="checkbox"/>	<input type="checkbox"/>
Audio recording during the interview	<input type="checkbox"/>	<input type="checkbox"/>
The data that I provide during this research may be used by Emeritus Professor Frank Archer, Dr Andrew Robertson and Joseph Cuthbertson in future research projects.	<input type="checkbox"/>	<input type="checkbox"/>

Name of participant: _____

Participant signature : _____

Date : _____

Interview Questions



MONASH University

Theme List of Initial Questions

‘Disaster Risk and the Social Determinants of Health – Profiling emerging risk in Oceania’

Project: ‘Disaster Risk and the Social Determinants of Health – Profiling emerging risk in Oceania’

Chief Investigator: Emeritus Professor Frank Archer, Dr Andrew Robertson, and Joseph Cuthbertson (PhD Candidate)

Welcome

Introduction: My name is Joseph Cuthbertson, and I am a PhD student at Monash Injury Research Institute (MIRI), Monash University Disaster Resilience Initiative (MUDRI) at Monash University examining ‘Disaster Risk and the Social Determinants of Health’.

Can I confirm with you that you have signed a consent form to participate in this research, that you have read the explanatory statement and that you are willing to have this interview recorded?

If at any stage you wish to terminate the interview, please let me know.

Would it be ok to commence the interview now?

Initial Questions:

- Question One:
- What do you believe are the top five disaster risks/ threats in the Oceania region today?
- What disaster risks do you believe are emerging in the Oceania region over the next decade?
- Why do you think these are risks?
- What are the drivers of these risks?
- Do you have any suggestions on how we can improve disaster risk assessment?
- Question Two:
- Are the current disaster risk plans and practices suited to the future Disaster risks?
- If not, why?
- If not, what do you think needs to be done to improve them?
- Question Three:
- What are the key areas of disaster practice that can enhance future community resilience to disaster risk?
- What are the barriers/inhibitors to facilitating this practice?
- What are the solutions/facilitators to enhancing community resilience?

Thank you for your time today.

Do you have any questions?

Are you happy for me to come back to you if I need further clarification?

APPENDIX B: STAGE 2 - ETHICS DOCUMENTATION

Explanatory statement



MONASH University

EXPLANATORY STATEMENT

‘Disaster Risk and the Social Determinants of Health – The Social Determinants of Health in Disaster Risk Reduction’

Project: ‘Disaster Risk and the Social Determinants of Health – The Social Determinants of Health in Disaster Risk Reduction’

Chief Investigator: Emeritus Professor Frank Archer	Student: Joseph Cuthbertson
Department: Monash University Disaster Resilience Initiative	Phone: +61 456 635 172
Phone: + 61 3 9905 1388	Email: jlcut3@student.monash.edu
Email : francis.archer@monash.edu	

You are invited to take part in this study, which is titled: ‘Disaster Risk and the Social Determinants of Health – The Social Determinants of Health in Disaster Risk Reduction’. Please read this Explanatory Statement in full before deciding whether or not to participate in this research. If you would like further information regarding any aspect of this project, you are encouraged to contact the researchers via the phone numbers or email addresses listed above.

What does the research involve?

The aim of the study is to investigate how the social determinants of health inform outcome indicators of disaster programs.

The rationale for undertaking Study 2 is to investigate how characteristics of population health relate to, and impact upon disaster risk, resilience, vulnerability, impact and recovery. The multi-disciplinary environment that contextualises disaster practice has the capacity to influence determinants of health. Current responses to address disaster risk independently by disciplines may be redundant or, at worst, conflicting. Identification of this influence, and coordination of programmed effort between disciplines has the potential to enhance societal wellbeing and reduce the human and economic costs associated with disasters.

Disasters continue to increase around the world in frequency and magnitude. My thesis on ‘Disaster Risk and the Social Determinants of Health’ seeks to investigate the causal effects of disasters and the incorporation of the social determinants of health as a holistic approach to disaster practice.

Contemporary evidence suggests that a systematic effort to analyse and manage the causal factors of disasters could achieve disaster risk reduction, rather than using traditional management processes.

To understand the drivers of disasters, broad actions requiring careful consideration include reduced exposure to hazards, decreased vulnerability of people and property, wise management of land and the environment, and improved community resilience and preparedness for adverse events. Robust (or lack thereof) determinants of health may influence the outcomes of disaster events upon an individual and/or a community.

Participants will be contacted via Skype at a time that is convenient for you and will participate in a one-on-one semi structured interview which will be audio recorded.

Why were you chosen for this research?

You were chosen for this research based on your experience as a community member who has experienced a disaster.

Source of funding

There is no funding for this project.

Consenting to participate in the project and withdrawing from the research

Please read and sign the consent form. The form can be returned either by fax or scanned and emailed back. You have the right to withdraw from further participation at any stage. It may not be possible to withdraw the data once the responses have been submitted.

Possible benefits and risks to participants

There is no expectation of any physical/psychological stress, inconvenience or discomfort with the interview process.

Confidentiality

Your responses will remain anonymous and only the researchers will have access to the original data.

Storage of data

Data will be retained for five years in a private office with security and in a locked filing cabinet that only the researcher will have access to.

Use of data for other purposes

The data provided may be used by the researchers in future projects including, but not limited to: PhD thesis, journal article/book/chapter, conference presentation, online web based and oral presentation. Only aggregate de-identified data will be used for other projects where ethics approval has been granted.

Results

Participants can contact the researchers and request a summary of the findings.

Complaints

Should you have any concerns or complaints about the conduct of the project, you are welcome to contact the

Executive Officer, Monash University Human Research Ethics (MUHREC):

Executive Officer

Monash University Human Research Ethics Committee (MUHREC)

Room 111, Building 3e

Research Office

Monash University VIC 3800

Tel : +61 3 9905 2052

Email : muhrec@monash.edu

Fax : +61 3 9905

3831

Thank you,

Chief Investigator's signature:

A handwritten signature in black ink, appearing to read 'Frank Archer', with a horizontal line underneath.

Chief Investigator's name: Emeritus Professor Frank Archer

Consent form



MONASH University

CONSENT FORM

'Disaster Risk and the Social Determinants of Health – The Social Determinants of Health in Disaster Risk Reduction'

Project: 'Disaster Risk and the Social Determinants of Health – The Social Determinants of Health in Disaster Risk Reduction'

Chief Investigator: Emeritus Professor Frank Archer
Department: Monash University Disaster Resilience Initiative
Phone: + 61 3 9905 1388
Email : francis.archer@monash.edu

Student: Joseph Cuthbertson
Phone : +61 456 635 172
Email : jlcut3@student.monash.edu

I have been asked to take part in the Monash University research project specified above. I have read and understood the Explanatory Statement and I hereby consent to participate in this project.

I consent to the following:	Yes	No
Taking part in a Skype/telephone interview, OR	<input type="checkbox"/>	<input type="checkbox"/>
Completing the questions electronically	<input type="checkbox"/>	<input type="checkbox"/>
Audio recording during the interview	<input type="checkbox"/>	<input type="checkbox"/>
The data that I provide during this research may be used by Emeritus Professor Frank Archer, Dr Andrew Robertson, Jose M Rodriguez-Llanes and Joseph Cuthbertson in future research projects.	<input type="checkbox"/>	<input type="checkbox"/>

Name of participant: _____

Participant signature : _____

Date : _____

Interview Questions



Theme List of Initial Questions

'Disaster Risk and the Social Determinants of Health – The Social Determinants of Health in Disaster Risk Reduction'

Project: 'Disaster Risk and the Social Determinants of Health – The Social Determinants of Health in Disaster Risk Reduction'

Chief Investigator: Emeritus Professor Frank Archer, Dr Andrew Robertson, Jose M Rodriguez-Llanes, and Joseph Cuthbertson (PhD Candidate)

Welcome

Introduction: My name is Joseph Cuthbertson, and I am a PhD student at Monash Injury Research Institute (MIRI), Monash University Disaster Resilience Initiative (MUDRI) at Monash University examining 'Disaster Risk and the Social Determinants of Health'.

Can I confirm with you that you have signed a consent form to participate in this research, that you have read the explanatory statement and that you are willing to have this interview recorded?

If at any stage you wish to terminate the interview, please let me know.

Would it be ok to commence the interview now?

Initial Questions:

1. What are the elements of a disaster resilient community?
2. Describe vulnerability
3. Are some groups in your community more vulnerable to disasters than others? Who? Why?
4. On a scale of 1 to 10 describe whether how vulnerable the following groups are:
 - a. Men
 - b. Women
 - c. Children (age <14yo)
 - d. Elderly
 - e. Disabled
 - f. Unemployed

- g. Indigenous
 - h. Non-English speaking
 - i. Local
 - j. Visitors
5. Is health important in the setting of disaster? Why?
 6. On a scale of 1 to 10, how important is health in reference to disaster resilience:
 7. What does it mean to be healthy?
 8. When assessing needs of community at risk or affected by disaster what are the top priorities?
 9. When disaster plans for communities are developed what should they provide, describe or plan for??
 10. On a scale of 1 to 10, rate whether the following traits increases or decreases an individual's disaster resilience (1: very low, 10: very high):
 - social gradient (where an individual is on the social ladder in each society)
 - Stress (where an individual is experiencing long term stress)
 - Early life experience (where an individual experiences early life development and education)
 - Social exclusion (where an individual experiences poverty, social exclusion, discrimination)
 - Work (where an individual experiences workplace stress and low control over their work)
 - Unemployment (where an individual has low job security or unemployment)
 - Social support (where an individual has friendships, good social relationships and strong social networks)
 - Addiction (where an individual has alcohol, drug or cigarette dependence)
 - Food (where an individual has a good diet and adequate food supply)
 - Transport (where an individual uses healthy transport options and has access to public transport)
 - Religion (where an individual is actively participating in faith-based activities)
 11. Are you male / female (Please circle as appropriate)?

12. Please indicate your age with a tick next to the corresponding figures on the scale below.

- ☐ Below 20
- ☐ 21 – 30
- ☐ 41 – 50
- ☐ 51 – 60
- ☐ Above 60

Thank you for your time today.

Do you have any questions?

Are you happy for me to come back to you if I need further clarification?

APPENDIX C: WADEM Position Statement: Accurate reporting of public health information

The mission of WADEM is the global improvement of prehospital and emergency health care, public health, and disaster health and preparedness. Accurate and transparent release of public health information is necessary to inform response and recovery activities associated with disasters.

The resolution to adopt the international health regulations in 2005 recognised the World Health Organisations leadership in monitoring and responding to public health emergencies[159].

Preservation of global health security is reliant upon timely reporting of emergencies and health threats to enable appropriate preparedness and response[160]

Withholding, suppression, delayed or deliberate inaccurate reporting of public health information presents a risk to of potential health threats to populations. The restriction of epidemiological health information hampers efforts to respond to events[161].

The transparent and timely release of public health information is logical, ethical and required to maintain and improve global health.

As such WADEM endorses that:

1. Global health security is reliant upon timely reporting of emergencies and threats to enable appropriate preparedness and response
2. Withholding, suppression, delayed or deliberate inaccurate reporting of public health information presents a risk of potential health threats to populations
3. That Customary International Humanitarian law recognizes the prohibition of attacks on, destruction of or render useless any public health infrastructure indispensable to the survival of the civilian population; that the Geneva Convention (Article 55 & 56) requires that any occupying power must restore the public health infrastructure and protections afforded to the civilian population to mitigate and prevent mortality and morbidity after any conflict or war; that this applies equally to post sudden-onset-natural disasters or public health emergencies of international concern necessary to protect the global health .
4. The accurate, transparent and timely release of official public health information is necessary to identify risks, provide health alerts and promote and protect global health.

APPENDIX D: Australian Journal of Emergency Management Monograph No 5 December 2019 AFAC19 Extended abstracts from the Bushfire and Natural Hazards CRC Research Forum Climate change as an emerging disaster risk in Australia and Oceania.

This extended abstract was published following presentation of findings based on extended research analysis related to emerging disaster risk in Oceania [162].

Climate change is recurrently cited as the most important perceived challenge of this century [98, 102]. Yet, the perceptions of the risk of climate change, its societal impacts, ramifications and particularly the solutions needed to address it require further investigation.

This study profiles regional emergency and disaster management professional's perceptions of climate change as an emerging disaster risk in Australia and Oceania. We aimed to examine what evidence exists to support decision making and profile the nature, type and potential human impact of climate change as an emerging disaster risk in Australia and Oceania.

Method:

Thirty individual semi-structured interviews with participants from nine different countries were conducted. All of the participants were engaged in disaster management in the Oceania region as researchers, practitioners in emergency management or disaster healthcare, policy managers or academics. Participants were interviewed to discern their perceptions of current disaster risk in the Oceania region and emerging disaster risks in the next decade.

Data collection was conducted between April and November 2017. Thematic analysis was conducted using narrative inquiry to gather firsthand insights on their perceptions of current and emerging threats and propose improvements in risk management practice to capture, monitor, anticipate and control disaster risk.

This study used The Sendai Framework for Disaster Risk Reduction as a conceptual framework to examine emerging disaster risk in Oceania

Results:

The majority of interviewees viewed climate change as a risk or hazard. When this perception was explored further a breadth of impacts in Oceania related to climate change were described. Hazards identified included climate variability and climate related disasters; increasing infectious disease related to climate change; increasing heatwaves; climate issues in island areas and loss of land mass; and trans-nation migration and increased transportation risk due to rising sea levels. A participant from Timor-Leste related that:

"We have already seen some evidence of the impacts of climate change, personally noticed difference in seasons, have seen significant new drought impact in East Timor"

An Australian participant described the effects of climate change on the natural environment and its relationship to disaster related to infectious disease; in particular,

'Climate change is increasing vector prevalence.'

The impact of climate change on basic needs was identified by a Pacific resident who voiced concern of the sustainability of small island states to support the needs of populations impacted by climate change. A concern of access to food and fresh water was expressed:

'Climate change causes migration due to food and water insecurity'

Moreover, a further respondent (Australian) described climate change as having an indirect, influencing affect across populations' vulnerability:

'Populations are vulnerable to emerging risks; overall vulnerability is increasing due to climate change with more hot days and less cool days.'

When participants described why they thought climate change was a risk, human impact on the natural environment featured strongly in participant responses. Descriptors included:

'Human development and its imbalance with nature'; 'increasing global warming influencing natural disaster risk'; and 'manmade causes/manmade impacts on planetary health,'

Insights on how climate change supported risk analysis and decision making varied between respondents. Geography, societal change and political will were key factors described:

'The location of Oceania lends itself to these risks. What's reported seems to indicate that they are escalating in size and population numbers are increasing therefore the footprint is increasing'.

This response is insightful in demonstrating that whilst Oceania has a natural disaster risk profile, the augmentation of natural disaster impact is related to both climate change and changes in population size and density.

Investigation of the relationship of society and governance in respect to disaster risk reduction and climate change produced findings that indicated challenges were perceived in upstream and downstream sections of communities. Whilst government inaction was voiced, it was also evident that there was a perceived lack of engagement at an individual level in some sectors of society:

'Government of the day not seeing them as a high priority in terms of mitigation due to cost, lack of government will alter current human impact trajectory'.

'Society is becoming more modernised and therefore more vulnerable to a lack of technology when it fails.... health systems are vulnerable in developed countries due to technology reliance and rapid/unsustainable urbanisation'.

'Weather, decreasing natural resources, affluent society have high expectations that may not be met post impact.... the sense of community has reduced over years particularly in big cities, in condensed areas there is an increased risk of disruption to basic needs.'

When examining barriers to improvement in understanding disaster risk, interviewees identified challenges related to risk appreciation of slow impact events and inadequate measurement of the long-term health effects of disaster:

‘The use of the word disaster is the Achilles heel in risk assessment as it has a connotation that infers a large event rather than a small event or slow burning/onset or series of small events - terminology is important in ensuring event capture’.

‘There is a lack of evidence to describe long term health effects associated with disasters and therefore investment in preventing or responding to these consequences. There is a lack of evidence for interventions and validation of them and little evaluation of determinants of risks associated with disasters – we need to look at determinants of an event not just the response’.

When examining solutions to improving disaster risk assessment a strong theme of community and individual engagement and responsibility emerged; particularly in reference to understanding and ownership of risk:

‘Ensuring grassroots training on preparedness and response on the disaster risks that are relevant to those communities. Providing training to communities and ensuring plans are local and relevant.’

‘Every community needs to own risk management strategy that is updated regularly with new and evolving knowledge. Urban planning needs disaster risk strategies built into them with detail. Then communicate these actions into the local population’

‘Improve connectedness in communities and knowing people and groups within them – this should be a function of disaster practice that creates trusted networks.

Discussion

The Lancet Commission reported climate change as “the biggest global health threat of the 21st century” [98]. This research investigated perceptions of current and emerging disaster risk in Oceania [92]. The majority of respondents resided in Australia. They associated climate change as a primary current and emerging disaster risk that threatens the safety and security of communities. Climate change has been identified as future hazard in Australia [60]. The National Strategy for Disaster Resilience has included climate change within its scope following the 2008 Australian Prime Minister’s National Security Statement [9, 61].

The Sendai Framework for Disaster Risk Reduction notes the importance of climate change, identifying it as a driver of disaster risk and articulates its relationship to disaster risk reduction and disaster risk assessment with a specific call for action on climate change and variability [26]. This policy tone indicates the relationship between the Sendai Framework for Disaster Risk Reduction and the United Nations Framework Convention on Climate Change Paris Agreement, and is demonstrative of the need for collaboration across disciplines and practice for comprehensive disaster risk reduction activities [26, 110]. Moreover, and directly related to the Oceania region, The Sendai Framework for Disaster Risk Reduction specifically identifies the vulnerability and risk of small island states for particular attention [26].

The findings of this study are consistent with previous research describing the health impacts of climate change. The fifth assessment report of the Intergovernmental Panel on

Climate Change (IPPC) has identified injuries, hospitalisation and deaths due to intense heat waves, fires and other weather disasters and changes in patterns and impacts of infectious disease [102]. Importantly the report notes that populations with low socio-economic status and pre-existing vulnerabilities are at greater risk of the impacts of climate change. Specific risks posed by climate change to populations in Oceania resulting in climate refugees have been previously reported by Weir et al who noted the intersection of climate change, conflict and disaster [111].

There is overlap between disaster risk reduction and adaption to climate change strategies. The increasing severity and intensity of natural disasters impacts many communities sensitive to changes in climate. Whilst disaster risk reduction embodies an 'all hazards' approach, focus on climate change adaptation strategies is required where socio-economic vulnerability is increased due to climate change.

Conclusion

Climate change is perceived as a significant contemporary and future disaster risk in the Oceania region. Strategies for action identified by respondents include improved government and community engagement in risk understanding, ownership and mitigation, and improved understanding of the long-term effects of disaster impact upon human health.