Disaster Risk Reduction
Methods, Approaches and Practices

Emily Ying Yang Chan
Rajib Shaw *Editors*

Public Health and Disasters

Health Emergency and Disaster Risk Management in Asia

Springer

Disaster Risk Reduction

Methods, Approaches and Practices

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Rajib Shaw, Keio University, Shonan Fujisawa Campus, Fujisawa, Japan

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Disaster risk reduction is a process that leads to the safety of communities and nations. After the 2005 World Conference on Disaster Reduction, held in Kobe, Japan, the Hyogo Framework for Action (HFA) was adopted as a framework for risk reduction. The academic research and higher education in disaster risk reduction has made, and continues to make, a gradual shift from pure basic research to applied, implementation-oriented research. More emphasis is being given to multi-stakeholder collaboration and multi-disciplinary research. Emerging university networks in Asia, Europe, Africa, and the Americas have urged process-oriented research in the disaster risk reduction field. With this in mind, this new series will promote the output of action research on disaster risk reduction, which will be useful for a wide range of stakeholders including academicians, professionals, practitioners, and students and researchers in related fields. The series will focus on emerging needs in the risk reduction field, starting from climate change adaptation, urban ecosystem, coastal risk reduction, education for sustainable development, community-based practices, risk communication, and human security, among other areas. Through academic review, this series will encourage young researchers and practitioners to analyze field practices and link them to theory and policies with logic, data, and evidence. In this way, the series will emphasize evidence-based risk reduction methods, approaches, and practices.

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ISSN 2196-4106 ISSN 2196-4114 (electronic)
Disaster Risk Reduction
ISBN 978-981-15-0923-0 ISBN 978-981-15-0924-7 (eBook)
https://doi.org/10.1007/978-981-15-0924-7

This Springer imprint is published by the registered company Springer Nature Singapore Pte Ltd.
The registered company address is: 152 Beach Road, #21-01/04 Gateway East, Singapore 189721, Singapore

Preface

Advancement in science technology in recent decades might have increased our capacity to tackle the adverse human consequences of various kinds of disasters, but the accompanied and interlinking modern phenomena of industrialisation, urbanisation, globalisation, climate change, and widening disparity have created new hazards and exacerbated the old ones, while aggravating people's exposure to these hazards and worsening the vulnerability of the marginalised at the same time, notably in Asia as the most disaster-prone continent. In the face of this dire prospect, the effective, efficient, and synergetic use of available resources for disaster risk reduction could provide an answer. Arguably, human health, or its inadequacy, is an inevitable outcome of disaster, while its enhancement a natural goal of disaster risk reduction (DRR), as enshrined in the landmark United Nations agreements adopted in this decade, including the Sendai Framework for Disaster Risk Reduction 2015–2030, the 2030 Sustainable Development Goals (SDGs), the Paris climate agreement, and the New Urban Agenda (Habitat III). Targeting the health aspect of DRR is thus an obvious route to take. Under the cluster approach instituted by the United Nations in 2006, health is among the 11 key areas where clusters have been established, and the global health cluster is led by the World Health Organization (WHO). Nevertheless, the health sector has traditionally focused on the response to disasters and emergencies.

In recent years, prevention and mitigation have been gradually recognised as a more efficient approach to tackle the health risk associated with emergencies and disasters. Preparedness of the stakeholders and resilience of the health systems based on primary health care at community level to reduce exposure and vulnerability are key concepts and practices under this emerging approach, which means multi-sectoral actors and their coordination are crucial. Consequently, the WHO (2019) has launched the Health Emergency and Disaster Risk Management (Health-EDRM) framework to weave together health, DRR, and other relevant disciplines to fill the theoretical gap and meet the practical needs in the new scene of DRR, with prevention as the pivot in this framework.

Comprising of 9 chapters of theoretical discussion and 14 case studies, this book presents the theoretical framework of Health-EDRM, places it within the global institutional context, and illustrates it within concrete examples from Asia, namely Bangladesh, China, India, Japan, Nepal, Pakistan, Vietnam, and the Philippines. How these case studies can illuminate the Health-EDRM framework and field of study and practice will be summarised before the way forward is explored to wrap up this multi-sectoral dialogue.

This book is intended for advanced undergraduate and postgraduate students, researchers, policy makers, and practitioners in related fields of DRR who are interested in looking at DRR from health in general, as well as its application in Asia. Our special thank goes to Chi Shing Wong of CCOUC for his meticulous support and coordination of this book project, as well as the unfailing editorial support from Asami Komada, Mariko Komaru, Dinesh Natarajan, Yosuke Nishida, Umamagesh Perumal and Taeko Sato at Springer.

Hong Kong SAR, China — Emily Ying Yang Chan
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About This Book

This book presents the research paradigm and research landscape of Health Emergency and Disaster Risk Management (Health-EDRM) with examples from Asia. The intersection of health and disaster risk reduction (DRR) has emerged in recent years as an interdisciplinary field of paramount human consequences. Throughout several landmark United Nations agreements adopted in 2015–2016, including the Sendai Framework for Disaster Risk Reduction 2015–2030, the 2030 Sustainable Development Goals (SDGs), the Paris climate agreement, and the New Urban Agenda (Habitat III), health is recognised as an inevitable outcome and a natural goal of disaster risk reduction, and the cross-over of the two fields is no doubt essential for the successful implementation of the Sendai Framework. Health emergency and disaster risk management, as a joint venture of this cross-over, has emerged as an umbrella field that encompasses emergency and disaster medicine, DRR, humanitarian response, community health resilience, and health system resilience.

Health-EDRM, however, remains to be developed into a coherent enterprise after the launching of the WHO Health-EDRM Framework in 2019. Key challenges with this new field of studies include un-coordinated research, lack of a strategic research agenda, limited development of multi-sectoral and interdisciplinary approaches, deficiency in the science–policy–practice nexus, absence of standardised terminology, and meagre coordination among stakeholders. This book provides a timely and invaluable resource for undergraduate and postgraduate students, researchers, scholars, and frontline practitioners as well as policy makers from across the component domains of Health-EDRM.

Contents

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Prof. Emily Ying Yang Chan serves as professor and assistant dean, Faculty of Medicine, and head, Division of Global Health and Humanitarian Medicine, The Chinese University of Hong Kong (CUHK); director, Collaborating Centre for Oxford University and CUHK for Disaster and Medical Humanitarian Response (CCOUC), Centre for Global Health (CGH) and Centre of Excellence (ICoE-CCOUC), Integrated Research on Disaster Risk (IRDR); co-chairperson, WHO Thematic Platform for Health Emergency and Disaster Risk Management Research Network; member, Asia Pacific Science Technology and Academia Advisory Group (APSTAAG); visiting professor, Oxford University Nuffield Department of Medicine; and fellow, FXB Center, Harvard University. Her research interests include disaster and humanitarian medicine, climate change and health, global and planetary health, human health security and Health Emergency and Disaster Risk Management (Health-EDRM), remote rural health, implementation and translational science, ethnic minority health, injury and violence epidemiology, and primary care. Awarded the 2007 Nobuo Maeda International Research Award of the American Public Health Association, Prof. Chan has published more than 300 international peer-reviewed academic, technical, and conference articles and 10 academic books. She also had extensive experience as a frontline emergency relief practitioner in the mid-1990s spanning 20 countries.

Rajib Shaw is a Japanese national of Indian origin, he is the professor in Graduate School of Media and Governance in Keio University's Shonan Fujisawa Campus (SFC). Earlier, he was the Executive Director of the Integrated Research on Disaster Risk (IRDR), a decade-long research programme co-sponsored by the International Council for Science (ICSU), the International Social Science Council (ISSC), and the United Nations International Strategy for Disaster Reduction (UNISDR). He is also the senior fellow of Institute of Global Environmental Strategies (IGES) Japan, and the chairperson of SEEDS Asia, a Japanese NGO. Previously, he served as a

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Chapter 1
Overview of Health-EDRM and Health Issues in DRR: Practices and Challenges

Emily Ying Yang Chan and Rajib Shaw

Abstract This chapter outlines the Health-EDRM framework as an emerging multidisciplinary subject of enquiry. This chapter explains key concepts that bridge health with disaster risk reduction and highlights the pivotal idea of disaster prevention in Health-EDRM. It discusses the challenges of this discipline, including the diverse research landscape, unified terminologies and data collection issues.

Keywords Disaster prevention · Disaster risk reduction · Health Emergency and Disaster Risk Management (Health-EDRM) · Health risk · Vulnerability

1.1 Introduction

Natural hazards, in the absence of risk reduction strategy, preparedness and management, might result in disaster events and lead to catastrophic human and economic impact. In 2015, an estimated 22,500 deaths and 100 million affected were reported to be attributable to disaster events globally (UNISDR 2015). Human impacts of disasters and emergencies are complex. Emergencies and disasters may cause direct and indirect impacts to health (examples of the latter include the disruption of life-line infrastructure, health systems and facilities). However, regardless of impact dimensions, adverse outcomes from disasters may cause major barriers to human development and progress.

Published literature and reports have already indicated that hazards, vulnerabilities, capacities and risks in emergency responses distribute unequally globally. However, impact of emergencies and disasters frequently affect disproportionally on vulnerable populations such as poor, extreme of ages, disabilities and ethnic

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E. Ying Yang Chan and R. Shaw (eds.), *Public Health and Disasters*, Disaster Risk Reduction, https://doi.org/10.1007/978-981-15-0924-7_1

minority group (Chan 2017). As developing countries tend to have less resilient systems and intrinsic capacity, when emergencies strike (e.g. climate-related ones), the human impact will likely to be more profound than in developed context. Even within a developed nation, the intra-nation variation in socioeconomic characteristics will result in different levels of vulnerabilities and results. People living in poverty are often considered as under high risks and "poverty reduction" has been proposed as essential components of vulnerability reduction for emergency. Health of extremes of age, i.e. children and older people, are particularly vulnerable in emergency and extreme disaster events. For instance, children represented 30–50% of mortality in disasters. In addition to socio-demographic vulnerabilities, context may also contribute to emergency risks. Highly crowded density, restricted point of access, limited crowd control, sudden change of weather, and lack of preparedness and medical support may all present as potential health risks in mass gathering events (WHO 2017a, b, c, d, e, f, g, h). Environmental and site preparedness, crowd safety, mass casualty preparedness for mass gathering requires good preparation for risk reductions and management. Meanwhile, it is almost impossible to report true impact of emergency on communities due to the lack of appropriate indicators to capture and the existing statistics reports might only reflect human suffering superficially. To protection population from the adverse health impact of crisis, proactive risk management has always been the objectives of people working in public health and related fields (Chan and Shi 2017).

Despite the challenges, with proper preparedness, coordination and resources, health risks encountered in emergencies and disasters might be reduced and minimized at all levels. Reports indicated that health sectors in only around 100 WHO member states have set aside separate budgets and resources for emergency preparedness and response (WHO 2008). Factors affecting response capacity might include suboptimal disaster risk management systems, lack of resources and knowledge and ongoing insecurity arising from conflict (WHO 2008). At the individual level, health risks might be conceptualized and addressed by looking into the vulnerability, exposure to a hazard or hazardous context, and how people might be exposed to, respond and manage such risks.

1.2 Health Emergency and Disaster Risk Management: Mainstreaming Health in Disaster Risk Reduction

The intersection of health and disaster risk reduction (DRR) has emerged as an interdisciplinary field of paramount human consequences in recent years. In a number of landmark United Nations agreements adopted in 2015–2016, including the Sendai Framework for Disaster Risk Reduction 2015–2030, the 2030 Sustainable Development Goals (SDGs), the Paris climate agreement, and the New Urban Agenda (Habitat III), health is recognized as an inevitable outcome and a natural goal of disaster risk reduction, and the crossover of the two fields is no

doubt crucial for the successful implementation of the Sendai Framework. Health Emergency and Disaster Risk Management (Health-EDRM), as a joint venture of this crossover to engage all relevant practitioners and researchers, has emerged as an overarching field encompassing emergency and disaster medicine, disaster risk reduction (DRR), humanitarian response, community health resilience, and health system resilience (CCOUC n.d.; Chan and Murray 2017; Lo et al. 2017; WHO 2019).

Health-EDRM is an academic paradigm that is actively being developed and evolved since 2009 (WHO 2008). The discipline aims to examine health and disaster risks and applies public health tools to engage in the management of health and disaster risk. In contrast to the traditional medical emergency and disaster approaches that are often response-based, the Health-EDRM paradigm targets systematic analysis and management of health risks. It emphasizes emergency preparedness and disaster risk reduction (Aitsi-Selmi and Murray 2015; Chan and Murray 2017) by adopting the preventive public health approach that addresses risks to reduce potential adverse impact and harm for all-hazard throughout the emergency cycle (WHO 2017g). A focus on prevention can also provide opportunities for developing research infrastructure in normal times. Research and alignment of actions in Health-EDRM may identify relevant health risks associated with a context, emergency and disaster situation (Chan et al. 2019). Its actions implement scientific evidence-based solutions and adopt policies that support preparedness, response and rehabilitation capacity building to enhance the resilience of a health system and its associated supporting systems.

Health-EDRM aims to consider all areas of risk management and determinants that might affect health (WHO 2017a, b, c, d, e, f, g, h). It argues that comprehensive, multidisciplinary approach should be used to analysis all-hazard risks within the emergency management cycle. This discipline invites the engagement of both health and non-health actors to understand the theories and frameworks that describe how human well-being, health risks and outcomes might be affected by hazards and disaster events. Health-EDRM also embraces multidisciplinary actors and adopts an inter-sectoral action approach to proactively prevent disaster- and emergency-related health risks. It also advocates for both top-down and bottom-up approaches as of equal importance to maximize impact management. As a scientific discipline, it aims to build relevant inter-sectoral and multidisciplinary frameworks and gather evidence to reduce health risks and impacts in crises and emergencies. The WHO launched the strategic framework in 2019 (WHO 2019) and in years to come, this book would serve as a useful resource and reference in this new field of study.

1.3 Key Challenges for Health-EDRM

The focuses as well as challenges of Health-EDRM research include the agreement within the academic and research community to adopt:

1. an all-hazards approach that incorporates the full spectrum of hazards that may cause disasters and crises;
2. a holistic all-needs approach, including physical, mental, and psycho-social health and well-being to support planning and examine outcomes;
3. disaster risk identification for populations with specific health needs such as children, people with disabilities, and the elderly;
4. identify evidence-based interventions facilitated during all phases of a disaster; and
5. research on and the building of health resilience in all communities. (CCOUC, n.d.).

As a new discipline, the fragmented nascent field of Health-EDRM, however, remains to be developed into a coherent enterprise (WHO 2019). Key challenges include non-alignment of research tools, lack of a strategic overarching research agenda, suboptimal development of multisectoral and interdisciplinary approaches, absence of the science–policy–practice nexus, deficiency in standardized terminology, and meagre coordination among stakeholders (Lo et al. 2017).

Moreover, there are general uncertainties about the agreed health indicators for Health-EDRM, as well as the absence of an agreed all-hazard and disasters classification for the purpose of Health-EDRM data collection. There is also a lack of consensus to account for thresholds relating to temporality (slow-onset versus protracted events), attribution (direct versus indirect causes of morbidity and mortality), and baseline data, working epidemiological definitions are urgently needed (Chan and Murray 2017).

When revisiting the research landscape in terms of the application of the preventive concept in research planning, implementation, and research ethics, Health-EDRM research needs to evolve beyond guidelines, codes, and approval processes. In view of the relatively neglected emergency health-related studies in the current research systems, the proactive adoption of the Health-EDRM approach may help create the conditions for conducting research in emergency and disaster situations in productive as well as ethical ways (Chan et al. 2019).

1.4 Application of Health-EDRM Framework in Asian Case Studies

This book attempts to provide the scientific, academic and practitioner communities an overview of the underlying concepts of Health-EDRM. It describes the key public health principles which will facilitate the conceptualization of health risks in times of emergencies and crisis. Specifically, these discussions aim to facilitate and familiarize the understanding of non-health readers towards key principles of public health and how health risks might be considered. It also describes actual case examples of how interventions and policies might be conceptualized under this

paradigm. It highlights the current gaps in infrastructure and knowledge of the discipline (Chan and Murray 2017; Chan et al. 2019).

This book has four main sections and 23 Chapters. *Section One* provides an overview of Health-EDRM in practices and challenges. *Section Two* includes six chapters that describe the important public health principles and theories that underlie the paradigm. Chapter 2 explains public health prevention hierarchy for the conceptualization of disaster context within a preventive perspective. Chapter 3 highlights how demographic and epidemiological transitions may present a complex picture to understanding health risks and community vulnerability in the twenty-first century. Chapter 4 analyses the current evidence gaps in bottom-up efforts for building a health resilient community. Chapters 5–7 delineate how Health-EDRM might address the four important global agendas of Sendai Framework for Disaster Risk Reduction, Paris climate agreement, United Nations Sustainable Development Goals and New Urban Agenda (Habitat III). *Section Three* consists of 14 Chapters (Chaps. 8– 21) that describe policies and programme initiatives that aim to address Health-EDRM in each of the contexts. Contributing authors share various actual policy and programme examples of how Health-EDRM might be applied in programmes and policy planning in disaster risk reduction of health. Chapter 22 of *Section Four* summarizes how these cases might contribute to the Health-EDRM discipline. The last chapter is the Epilogue of this book, including a discussion of the current gaps remained unaddressed in the paradigm.

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Chapter 2
Public Health Prevention Hierarchy in Disaster Context

Emily Ying Yang Chan and Chi Shing Wong

Abstract The public health prevention hierarchy—namely primary, secondary and tertiary prevention, is one of the most important public health principles which guide policy and programme development. Primary prevention attempts to prevent the onset of disease or reduce health risks. Strategies may include health protection and health promotion. Health protection can be carried out through the establishment of policies, regulations and programmes (e.g. vaccinations), while health promotion mainly involves health education and information sharing. Secondary prevention refers to stopping disease progression. Related activities aim to detect disease early and thus increase the opportunity for early intervention to prevent progression and symptom development. Screening is a classic example of secondary prevention. Tertiary prevention focuses on the rehabilitation of patients with an established disease to minimise residual disabilities and complications. It aims to restore bodily functions that have been impaired by the disease and impact. Treatment, rehabilitation and palliative care are examples of the tertiary prevention services. This chapter applies public health prevention hierarchy in disaster prevention and response. The application of these prevention concepts to support Health-EDRM in establishing disaster mitigation strategies, response programmes and post-disaster recovery policies may enhance individual survival and protect communities from adverse health outcomes in natural disasters in a cost-effective way.

Keywords Disaster risk management · Disaster risk reduction · Health Emergency and Disaster Risk Management (Health-EDRM) · Prevention hierarchy

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E. Ying Yang Chan and R. Shaw (eds.), *Public Health and Disasters*, Disaster Risk Reduction, https://doi.org/10.1007/978-981-15-0924-7_2

2.1 Introduction

Health-EDRM aims to put people's health at the centre of emergency and disaster risk management. Internationally, it is advocated by World Health Organization (WHO) and enshrined in such disaster-related international policy frameworks as the Sendai Framework for Disaster Risk Reduction 2015–2030, Sustainable Development Goals and Paris Agreement on climate change. The framework demands a stronger role for science and for all stakeholders and groups (including women, children, people with disabilities and older people) in disaster risk management. In addition to fitting into this multi-stakeholder bottom-up approach to disaster risk management, the public health prevention concept arguably also provides one of the key hinges to unify this emerging field of Health-EDRM as a crossover between health and disaster risk reduction encompassing the disciplines of emergency and disaster medicine, DRR, humanitarian response, community health resilience, and health system resilience. World Health Organization suggests the goal for Health-EDRM as minimising the health impact of emergencies and disasters, while the prevention concept captures the crux of cost-effectiveness behind various means to this end WHO has suggested, e.g. safe hospitals to mitigate negative public health consequences post-disaster, safe water supply to reduce exposure to hazards, vaccinations to minimise vulnerabilities, mass casualty response plans to strengthen local capacities for response and recovery, and community health care to build local health resilience (WHO 2015).

Under the Health-EDRM framework, emergency and disaster risk management policies, activities and programmes involving multidisciplinary sectors can help avoid or reduce the health impacts of disaster, such as deaths, injuries, diseases, disabilities and psychosocial problems. WHO highlights Health-EDRM as referring to the systematic analysis and management of health risks posed by emergencies and disasters. Through reduction in hazard, exposure and vulnerability, better preparedness, response, and recovery could be expected. Although the traditional focus of the health sector in emergencies and disasters has been on the clinical on-site response to and survival in emergencies and disasters, Health-EDRM will re-direct this focus to enhancing the upstream aspects of preparedness and hazard, exposure and vulnerability reduction. It emphasises prevention and capacity development of community and country to provide timely, planned and resource-effective response and recovery, as well as building resilient health systems based on community-level primary health care. These attempts will reduce community vulnerability, protect health facilities and services, and scale-up health response to meet the surging health needs post-disaster (Chan and Murray 2017; WHO et al. 2017).

The prevention-focused Health-EDRM also echoes with the Sendai Framework's expected outcome ("The substantial reduction of disaster risk and losses in lives, livelihoods and health"), goal ("Prevent new and reduce existing disaster risk 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 resilience.") and three of its seven global targets ("Reduce disaster mortality, reduce the number of affected people, and reduce disaster damage to critical infrastructure and disruption of basic services, including health facilities") (United Nations Office for Disaster Risk Reduction 2015).

This chapter applies public health prevention hierarchy in disaster context to provide a conceptual skeleton for Health-EDRM. The application of these prevention concepts in establishing disaster mitigation strategies, response programmes and post-disaster recovery policies may facilitate better individual survival and protect communities from adverse health outcomes in natural disasters.

2.2 Hierarchy of Prevention

In public health, prevention is often divided into *primary prevention* (the prevention of disease from the source in the first place, for example, through providing clean water or immunisation against infectious diseases), *secondary prevention* (the early detection of an infectious disease at an early stage when it can be treated or contained, through periodic health surveillance) and *tertiary prevention* (prevention of disability, for example, by providing rehabilitation services after an injury).

The classical framework of Leavell and Clark (1958) suggests three levels of health prevention, namely primary, secondary and tertiary prevention. **Primary prevention** concerns measures that prevent the onset of diseases at the source. Strategies may include health protection and health promotion, the former can be carried out through the establishment of health policies and regulations as well as the provision of clean water or vaccinations against infectious diseases, while the latter mainly involves health education. **Secondary prevention** refers to blocking the progression of a disease after its onset. It aims at an early detection of a disease by such means as screening to increase the opportunity for successful interventions to prevent the progression of the disease and the emergence of symptoms. Another example is the detection of an infectious disease at an early stage when it can be treated or contained, through periodic health surveillance. **Tertiary prevention** focuses on rehabilitating patients suffering from an established disease to minimise complications and disabilities. It aims to restore bodily functions that have been impaired by the disease. Interventions in this category include treatment, rehabilitation and palliative care. The translation of these prevention concepts in Health-EDRM may enhance individuals' survival and protect communities from adverse health outcomes brought about by natural disasters (Leavell and Clark 1958; Department of Health of the Government of the Hong Kong Special Administrative Region 2008).

Health protection and health promotion are two major strategies to achieve the goal of disease prevention. Health protection strategies focus on controlling or removing health hazards, slowing down disease progression and reducing the

impacts of established diseases with a wide range of primary, secondary and tertiary prevention strategies; while health promotion strategies focus on encouraging healthy behaviours and lifestyle to improve well-being and to reduce the risk of developing diseases, which are mostly in the realm of primary prevention.

2.3 Disasters

There are various ways of classifying disasters. One of the common ways to classify disasters is based on the nature of the triggering cause or hazard, namely, natural disasters, human-caused disasters and complex emergencies. Meanwhile, classification based on cause has the merit of targeting prevention efforts under the Health-EDRM framework.

Natural disasters are disastrous events triggered by hazards of natural origin. The Centre for Research on the Epidemiology of Disasters (CRED) of the Université catholique de Louvain in Belgium further classifies natural disasters into six major subcategories (CRED n.d.; Below et al. 2009; Chan 2017):

- **Geophysical disasters**: Events originating from the earth's solid surface and its interior;
- **Meteorological disasters**: Events caused by short-term, microscopic atmospheric processes;
- **Hydrological disasters**: Events caused by deviations in the normal water cycle or overflow of bodies of water caused by strong wind;
- **Climatological disasters**: Events caused by long-term, meso- to macro-scale processes;
- **Biological disasters**: Events caused by the exposure of humans or livestock to germs or toxic substances;
- **Extraterrestrial disasters**: Events caused by asteroids, meteoroids and comets which pass near the earth or strike the earth, or any changes in interplanetary conditions that affect the earth's magnetosphere.

Specifically, climatological, hydrological and meteorological disasters can be grouped together as hydro-meteorological disasters. Together with biological disasters, they are natural disasters with direct associations with the climate system and thus affected by global climate change.

Human-caused disasters are disastrous events arising from human-related hazards, either unintentionally (e.g. traffic accidents, industrial accidents, nuclear accidents and hazardous material spills) or intentionally (e.g. wars and terrorist attacks) (United States Federal Emergency Management Agency [FEMA] 2008, D-32). Human-caused disasters may range from technological disasters to bioterrorism. Technological disasters can result from human errors or breakdown of technological systems, which can be further categorised into: industrial accidents

(collapses, explosions, fires, gas leaks, poisoning, radiation and others), transport accidents (rail, road, water and air) and miscellaneous accidents (Chan 2017).

A complex emergency is "[a] multifaceted humanitarian crisis in a country, region or society where there is a total or considerable breakdown of authority resulting from internal or external conflict and which requires a multi-sectoral, international response that goes beyond the mandate or capacity of any single agency and/or the ongoing UN country programme" (United Nations Office for the Coordination of Humanitarian Affairs [OCHA] 2003, p. 9). Complex emergencies often occur in settings having experienced protracted disruptions to livelihoods (by warfare, civil disturbance and large-scale population movements). It might induce violence and illegal actions. In these settings, many people are forced to leave their homes to seek refuge elsewhere or escape from the destruction of their homes, hunger, diseases and persecution. These people become internally displaced persons (IDPs) when they moved to other places inside their own country, or become refugees when they cross national borders.

While UNISDR suggests that disaster prevention refers to "[t]he outright avoidance of adverse impacts of hazards and related disasters… through actions taken in advance" (United Nations International Strategy for Disaster Reduction [UNISDR] 2009, p. 22), the public health approach to prevention could enrich the content of and deepen the understanding towards disaster prevention by delineating three levels of prevention.

Figure 2.1 displays the hierarchy of prevention in Health-EDRM. In disaster settings, primary prevention may be represented as the lowest level of the pyramid. These activities target the wider community and cover the largest proportion of preventable health impact. Secondary prevention focuses on a smaller population directly affected by a disaster. Tertiary prevention concerns only those who have already experienced the health impact of a disaster, which constitute a small portion of the affected population. The per capita cost of the preventive measures tends to increase as intervention choices migrate up the hierarchy. Typically, prevention at the primary level tends to be the most cost-effective.

In the context of disaster preparedness, **primary prevention** proactively addresses the potential health risks associated with hazards and disaster events beforehand, so as to prevent the onset of negative health impact. Its activities aim to prepare for and enhance resilience before a disaster. For example, in flood-prone areas, heavy rainfall might bring about stagnant water that can become breeding sites for mosquitoes and hence increase the risk of vector-borne diseases, such as malaria, dengue fever, Japanese encephalitis and West Nile fever (World Health Organization Regional Office for the Eastern Mediterranean [WHO-EMRO] 2005). Primary prevention activities include building structures that avoid the formation of water traps and the accumulation of stagnant water, as well as the promotion of activities and raising community awareness of the disease risks associated with stagnant water. In earthquake-prone areas, design and building codes of seismic-resistant hospitals is another example of primary prevention to minimise the direct health impact of disasters and the health risk associated with disruption of health services by disasters (World Health Organization (WHO), United Kingdom Health

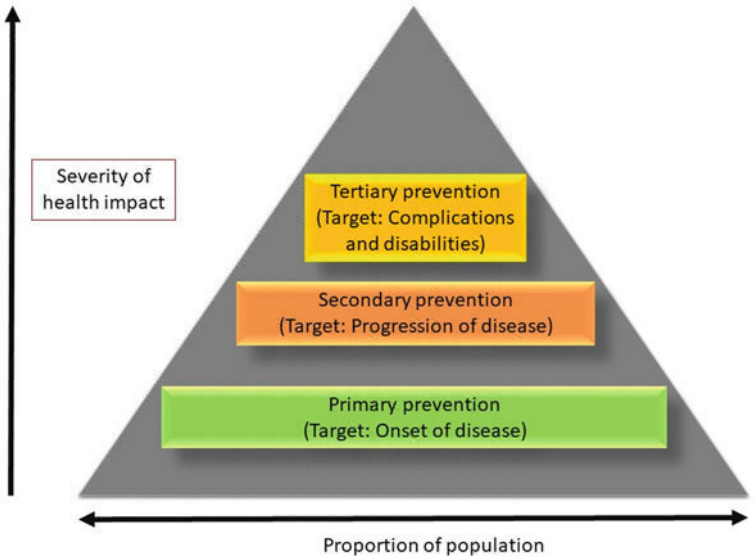

Fig. 2.1 Hierarchy of prevention pyramid in Health-EDRM

Protection Agency (HPA), & partners 2011c). The World Health Organization recognises the crucial role of hospitals in a disaster and made specific guidelines to promote safe hospitals (World Health Organization Regional Office for the Western Mediterranean [WHO-WPRO] 2010).

For technological disasters, preventive measures that aim at the primary level should attempt to reduce the negative health outcomes (e.g. mortality and morbidity in terms of injuries, disabilities or chronic diseases). Specific guidelines and emergency-related training should be implemented in industries. For instance, to prepare for a chemical release in chemical incidents or radiation emergencies, guidelines and training should cover relevant scenario analyses, impact assessment, training as well as equipping responders to deal with loss of containment (World Health Organization (WHO), United Kingdom Health Protection Agency (HPA), & partners 2011a). For radiation emergencies, continuous monitoring of the environment and high-risk groups should be applied (World Health Organization (WHO), United Kingdom Health Protection Agency (HPA), & partners, 2011b).

Secondary prevention in disaster settings refers to actions addressing the health risk and its response during the immediate aftermath of a disaster, including blocking the spread of diseases (or other negative health conditions) and their adverse health impact. For instance, to avoid an increased burden of clinical consultations after the onset of a disaster, the health needs of people with chronic disease conditions (e.g. drugs and specific diet requirements) should be proactively managed (e.g. via maintenance of drug supply) to avoid medical complications due to lack of management. Even with limited resources and capacity in post-disaster settings, there are always ways to support populations with chronic conditions after

disasters. For example, giving health advice incurs relatively little operation cost but has potential long-term implications for disease prevention. In another example of nuclear reactor accidents where radioactive materials may be released into the environment, the World Health Organization has developed guidelines for iodine prophylaxis during nuclear accidents and recommended that iodine tablets should be distributed among the affected population to minimise the potential harm arising from radiation, due to the concerns over radioactive contamination of food and water and the associated risk of thyroid cancer (WHO 1999). To implement meaningful preventive-based relief programmes, however, it is pertinent to emphasise the need to collect relevant demographic profiles, health information, knowledge, attitudes and behaviour information during health needs assessment so as to design and implement relevant programmes according to the project needs.

In a disaster context, **tertiary prevention** aims to minimise the impact on and damage to human health post-disaster. Tertiary prevention measures target people who have already suffered from the negative health impact of the disaster, but aim to prevent poor outcomes (such as death). For example, after an earthquake, patients might suffer from orthopaedic trauma and require operations. While rapid clinical operations could save lives, it is also important to offer early post-operational physiotherapies to maximise functional recovery potential of the patients (e.g. amputees).

Figure 2.2 illustrates the application of preventive hierarchy in a Health-EDRM framework in an example of managing the health risk of cholera outbreak post-disaster.

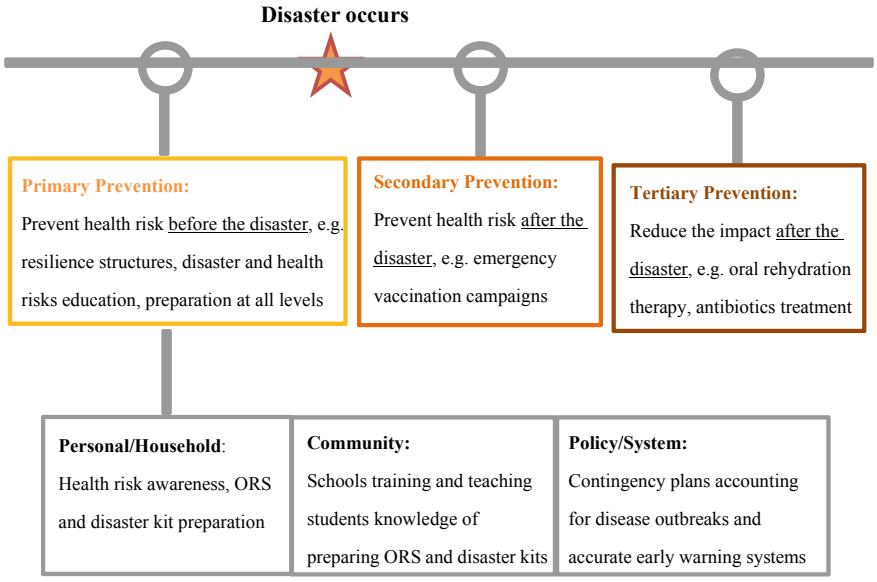

Fig. 2.2 Components of the prevention concept in the Health-EDRM framework against potential cholera outbreak post-disaster

2.4 Health Risk Transition

The hierarchy of prevention model is further supplemented by the notion of "health risk transition" to help prioritise Health-EDRM policies and actions in countries at different development stages.

Health risk transition can be considered a logical extension of the double transitions, i.e. demographic and epidemiological transitions. The classical demographic transition is the transition from high birth and mortality rates to lower birth and mortality rates as a country undergoes industrialisation (Caldwell et al. 2006). During the demographic transition as a result of industrialisation and modernisation, the mortality rate of a society starts to drop as a result of improved food access and nutrition on the one hand, and advances in public health and medicine on the other. The decline in birth rate picks up later and results in lower birth and mortality rates, as well as longer life expectancy. As a result of better hygiene, nutrition and healthcare, there sees the epidemiological transition where communicable diseases start to recede while chronic non-communicable diseases constitute an increasing portion of the disease burden. The mechanism of this epidemiological transition is further explicated by a third parallel transition, the health risk transition.

World Health Organization proposed the concept of risk transition in its *World Health Report 2002*. Risk is defined as "a probability of an adverse outcome, or a factor that raises this probability" (WHO 2002, p. 7) and the report described the amount of disease, disability and mortality in the world that could be attributed to some common modern risks to human health, i.e. the top ten risks in terms of the burden of disease they cause. According to the report (WHO 2002), the ten leading risk factors globally were found to be: underweight; unsafe sex; high blood pressure; tobacco consumption; alcohol consumption; unsafe water, sanitation and hygiene; iron deficiency; indoor smoke from solid fuels; high cholesterol; and obesity, which accounted for more than one-third of total deaths in the world. However, it pointed out that these risk factors varied between countries of different development stages.

In many developing countries in sub-Saharan Africa and Southeast Asia, more than 30% of the total disease burden resulted from three of these global top ten risks, namely underweight, unsafe sex and unsafe water, sanitation and hygiene. The top risk factor of underweight alone accounted for more than 3 million child deaths in these countries, where poverty was a strong underlying health determinant. Besides, it was also estimated that more than 99% of the HIV infections in Africa in 2001 were attributable to unsafe sex. The WHO (2002) report estimates that about an annual 1.7 million deaths worldwide were attributed to unsafe water, sanitation and hygiene, mainly through infectious diarrhoea. Around 90% of the deaths were children and almost all of the deaths were found in developing countries. In both Africa and Asia, indoor smoke from solid fuels, zinc deficiency and iron deficiency were the leading risks for disease, which are also closely associated with poverty.

In more developed middle-income countries like China and those in Latin America, five risk factors (alcohol consumption, high blood pressure, tobacco consumption, underweight and overweight) have been shown to cause more than one-sixth of all disease burden. In the most developed countries in North America, Europe and the Asia-Pacific, at least one-third of all disease burden was attributable to tobacco consumption, high blood pressure, alcohol consumption, high cholesterol and obesity, which are related to "overconsumption" at the other end of the risk factor scale as compared with poverty and are mostly lifestyle related. However, these risk factors and the diseases associated with them are becoming more prevalent in developing countries, where they have created a double disease burden in addition to the remaining communicable diseases that have been afflicted poorer countries. The more developed middle-income countries suffered a double burden of risks, with their top six risk factors including all the top five overconsumption-related risks and the top poverty-related risk factor. The WHO (2002) report estimated that the number of deaths attributable to tobacco consumption in the year 2000 was 4.9 million, over 1 million more than it was in 1990. Although most of the smoking-related disease burden remained to be found in industrialised countries, the increase was most marked in developing countries, which demonstrates a shift of health risk. Similarly, while alcohol contributed to a higher proportion of death and disease burdens in the Americas and Europe, alcohol consumption has been increasing in developing countries.

This transition of health risks suggests that these health risks have shifted as a result of the development and modernisation of a society. WHO (2002) reported that the five overconsumption-related risk factors of high blood pressure, tobacco consumption, alcohol consumption, high cholesterol and obesity were part of a "risk transition" associated with marked changes in lifestyles in many parts of the world. In many developing countries, rapid increases in body weight have been observed, particularly among children, adolescents and young adults. From 1980 to 2000, obesity rates have risen threefold or more in some parts of the developed North America, Australasia and Eastern Europe, as well as the developing China, the Middle East and the Pacific Islands. While eating fruit and vegetables can help prevent cardiovascular diseases and some cancers, the low intake of them was responsible for almost 3 million deaths a year from those diseases during the turn of the millennium. The emergence of these health risks is attributable to changes in food processing and production and in agricultural and trade policies, which have changed people's daily diet and are in increasing trends among those in developing countries.

Meanwhile, changes in living and working patterns as a result of industrialisation and modernisation have led to less physical activity and less physical labour. The WHO report (2002) finds that physical inactivity was associated with about 15% of some cancers, diabetes and heart disease. The less-regulated marketing of tobacco and alcohol in developing countries also exposed more people to such products, which pose serious long-term health risks. For example, studies found that the death rates among smokers of all ages were two or three times higher than those of non-smokers.