EFFECTS OF VARIOUS DISASTER MANAGEMENT APPROACHES: AN EVIDENCE SUMMARY

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Picture

LIST OF ABBREVIATIONS

ADPC	:	Asian disaster preparedness center
AMSTAR	:	Assessment of multiple systematic reviews
ASEAN	:	Association of southeast asian nations
CBDRM	:	Community based disaster risk management
CDMP	:	Comprehensive disaster management programme
CPP	:	Cyclone preparedness programme
DDM	:	Department for Disaster Management
DFID	:	Department for International Development
DMA	:	Disaster Management Act
DMB	:	Disaster Management Bureau
DRR	:	Disaster risk reduction
EM-DAT	:	Emergency events database
EOC	:	Emergency operation centres
EPPI-Centre	:	Evidence for Policy and Practice Information and Coordinating Centre
GBP	:	Great Britain pound
GFDRR	:	Global Facility For Disaster Reduction And Recovery
GLOFs	:	Glacial lake outburst floods
GoO	:	Government of Odisha
HFA	:	Hyogo Framework for Action
HIC	:	High income countries
ICHARM	:	International Centre for Water Hazard and Risk Management
ICIMOD	:	International Centre For Integrated Mountain Development
ICRC	:	International Committee of the Red Cross

IDNDR	:	International Decade for Natural Disaster Reduction
IFRC	:	International Federation of Red Cross
IIED	:	International Institute for Environment and Development
IPCC	:	Intergovernmental Panel on Climate Change
ISDR	:	International Strategy for Disaster Reduction
ISO	:	International Organization for Standardization
LMIC	:	Low and middle-income countries
MAPDRR	:	Myanmar action plan on disaster risk reduction
MDGs	:	Millennium Development Goals
NDM	:	National Disaster Management
NDMA	:	National Disaster Management Authority
NDMO	:	National disaster management ordinance
NDMP	:	National disaster management plan
NDRF	:	National disaster response framework
NDRMF	:	National disaster risk management framework
NDRRP	:	National disaster risk reduction plan
NGO	:	Non-governmental organisation
NGOs	:	Non-governmental organisations
NIDM	:	National Institute of Disaster Management
NPDM	:	National policy on disaster management
ODI	:	Overseas Development Institute
OSDMA	:	Odisha State Disaster Management Authority
PICOS	:	Population, intervention, comparison, outcomes and study design
PRISMA	:	Preferred reporting items for systematic reviews and meta analyses
PwC	:	Pricewaterhousecoopers pvt. Ltd.

QAT	:	Quality assurance team
SAARC	:	South Asia Association for Regional Cooperation
SADKN	:	South Asian Disaster Knowledge Network
SARH	:	South Asia Research Hub
SDGS	:	Sustainable development goals
SDMC	:	Saarc disaster management centre
SFDRR	:	The Sendai Framework for Disaster Risk Reduction
SOD	:	Standing orders on disaster
SR	:	Systematic review
TERI	:	The Energy and Resources Institute
UNDP	:	United Nations Development Programme
UNEP	:	United Nations Environment Programme
UNESCAP	:	United Nations Economic And Social Commission For Asian And The Pacific
UNICEF	:	United Nations Children's Emergency Fund
UNISDR	:	United Nations International Strategy for Disaster Reduction
UNISDR	:	United Nations International Strategy for Disaster Reduction
UNOCHA	:	United Nations office for the Coordination of Humanitarian Affairs
VDC	:	Village development committee
VGI	:	Volunteered geographic information
WCDRR	:	World Conference on disaster reduction
WHO	:	World Health Organization

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EXECUTIVE SUMMARY

ABSTRACT

This evidence summary attempts to summarise the review-level evidence on the effectiveness of disaster management approaches in low and middle income countries, and to contextualize the evidence to provide policy-makers with a reliable basis for informed decision-making regarding the applicability and transferability of different disaster management interventions to South Asian settings, with particular emphasis on Bangladesh. Interventions have been systematically reviewed as per four phases of disaster management cycle – the 4 Rs (risk mitigation, response readiness, response execution, and recovery). Positive evidence of effectiveness was found for medical interventions; capacity, education and training; cash based interventions; communication and information; mechanisms and models of coordination. Evidence of harm was reported for communication and information by one review. However, insufficient or inconclusive evidence was reported for various interventions such as adaptation measure; behavioral theories and models; crisis management; emergency management and infrastructure; insurance; international humanitarian assistance; preparedness tools and guidelines etc. South Asian countries face various challenges in managing natural disasters due to availability of limited healthcare resources such as infrastructure, health professionals, medical importunes etc. Given the major challenges faced by South Asia including Bangladesh, the main interventions which are found to be effective and can be useful for the country in disaster management are: i) use of community based approaches both for medical and communication intervention; ii) promoting and strengthening school based disaster education; iii) coordination among agencies; iv) cash based interventions through local financial institutions. It emerges from the evidence summary that interventions which were sensitive to the socio- cultural context and practices of the target region had a more positive impact and wider acceptance. Thus, there is a need to devise necessary and appropriate strategies to counteract exclusion processes in disaster management for inclusive outcomes. Even though the evidence reviewed offers some insights, there has been a paucity of rigorous research on effectiveness of disaster management approaches for South Asia, which limits the strength of the contextualisation.

BACKGROUND

Natural hazards and their associated risks have continued to occur and are perceived to increase further in complexity, magnitude, and frequency. The destruction caused by natural hazards can lead to large-scale losses of life and property, especially in areas with high population and economic investment concentration (Diley et al., 2005). South Asia, owing to its diverse geo-climatic characteristics, is prone to a variety of natural hazards. Between 1990 and 2015, the region faced a total of 1,792 natural disasters, which resulted in the loss of around one million lives, affected more than 2.6 billion people and incurred a damage of approximately USD 165 billion (EM-DAT, 2016). These figures are, by far, the highest among the recorded disasters in various geographic regions of the world. In 2015 alone, South Asia was the most disaster prone region in the world, recording 52 disasters and 14,647 deaths that accounted for a staggering 64 per cent of total global fatalities (UNESCAP, 2015).

In research domain, Disaster Management (DM) is a relatively new field and has received much attention post 1990s, essentially following a series of natural disasters that are still occurring. The disaster policy planning in the developing countries, especially in the South and South East-Asian countries, seems to be developing under the influence of past significant disaster events. The literature on disaster management is varied and extensive. However, fewer studies evaluate the effectiveness of the various disaster management approaches for long-term outcomes. In light of the importance and advantages of evidence based decisions, evidence summaries can be beneficial in broadening the spectrum of evidence use, incorporating various contexts and in avoiding duplication of effort by drawing results from existing studies and reviews which cater to disaster management approaches.

OBJECTIVES

The aim of this evidence summary is to summarise the review-level evidence on the effectiveness of disaster management approaches in low and middle income countries, and to contextualise that evidence for the South Asian region. To understand and evaluate the different types of interventions, the four phases of disaster management cycle – the 4 Rs (risk mitigation, response readiness, response execution, and recovery) – have been integral to the evidence summary. Interventions have been systematically reviewed as per each phase of disaster management.

REVIEW METHODS

The team followed standard methodological procedures in preparing this evidence summary that are used in conducting a systematic review. The primary steps were conceptualisation, identification of studies (search, screen), appraisal and data extraction, synthesis, and contextualising. The team conducted comprehensive searches of published and unpublished literature. Two independent research assistants screened all identified studies to determine eligibility for inclusion in the review. From all included studies, data was extracted using a standardized coding tool and we critically appraised the studies using existing tools appropriate for the different study designs.

RESULTS OF SCREENING, DATA EXTRACTION AND SYNTHESIS

Out of 4,365 studies identified in the extensive search of electronic databases and websites of relevant organizations, 49 documents were included on the basis of two stage inclusion and exclusion criteria. While appraising the quality of the studies, 47 systematic reviews were included for analysis and synthesis post applying inclusion and exclusion criteria. Given the heterogeneity of the interventions and outcomes reported in the included SRs across the four phases of disaster management, narrative synthesis was used for data extraction and synthesis.

Among the included SRs, 38 SRs reported on a total of 60 outcomes and the remaining SRs were either empty or did not report any outcome. Many SRs dealt with more than one outcome and provided different conclusions and evidence for each outcome. Some reviews have also reported multiple outcomes for a single intervention. Out of the 60 reported outcomes, evidence was reported for 37 outcomes. Within these 37 outcomes of evidence, positive evidence of effectiveness was provided for 13 outcomes, insufficient evidence for 19 outcomes and inconclusive evidence for three outcomes. Interestingly, evidence of harm was also reported for one outcome. Among 13 reported outcomes

with positive evidence of effectiveness, eight SRs provided a narrative synthesis. In the remaining outcomes, three reviews undertook a meta- analysis and two did a numerical analysis.

The included SRs span a number of disaster management interventions across different disaster management phases. Each SR included in the evidence summary dealt with one specific disaster management intervention which spread across more than one stage of disaster management. All the interventions were grouped under 18 broad categories of interventions (**table 3.3**). Among the included reviews, the majority of SRs have focused on interventions for response execution and few reviews have focussed on risk reduction.

SUMMARY OF EVIDENCE

Of the above listed categories of interventions, conclusive evidence of effectiveness (positive or negative) was reported only in terms of the following categories of interventions: medical interventions and rehabilitation; capacity, education and training; cash based interventions; mechanisms and models of coordination; and communication and information. Except for the five categories of disaster management interventions discussed below, SRs did not conclude clearly on effectiveness of interventions.

POSITIVE EFFECT OF INTERVENTIONS

MEDICAL INTERVENTIONS AND REHABILITATION

Positive effects of medical intervention and rehabilitation for disaster management were reported by six SRs. Five of these SRs were in the nature of psychological and psychosocial interventions, and one was physiological in nature. Further breakdown by type of intervention is provided below:

- Psychological interventions (such as Psychological aid, Cognitive Behavioural Therapy (CBT), Eye Movement Desensitization and Reprocessing (EMDR) etc.) had positive health outcomes in the form of psychological wellbeing (Lopes et al., 2014; Newman et al., 2014; Khan et al., 2015).
- Psychological rehabilitation programmes resulted in improved mental and psychological health (Fu et al., 2015).
- Psychosocial programmes (such as CBT, narrative exposure therapy, meditation relaxation therapy etc.) had positive effects on reduction in PTSD symptoms and led to improvement in psychological wellbeing (Lipinski et al., 2016).
- Anti-retroviral therapy (ART) in disaster settings was found to be satisfactory on the parameters of mortality, follow up, and patient retention (Griffiths & Ford, 2013).

CAPACITY, EDUCATION AND TRAINING

Three SRs reported positive effect of capacity building interventions. Interventions included in the SRs are disaster education programs for children and capacity building of hospital staff through disaster drills. Results of the SRs are outlined below:

- School based disaster education of teenagers had positive effect in enhancing their disaster knowledge, risk perception, and mitigation/response skills (Codreanu et al., 2014; Johnson et al., 2014).
- Disaster drills for hospital staff was found to be effective in making hospital staff familiar with disaster procedures and response (Hsu et al., 2004).

CASH BASED INTERVENTIONS

Positive effect of cash based interventions in disaster settings (primarily on food security) was discussed only by one SR. They found out that both cash based interventions (such as unconditional or conditional cash transfer) and in-kind assistance (such as voucher programme) was effective in increasing and maintaining household food security among drought-affected populations (Doocy & Tappis, 2016)

MECHANISMS AND MODELS OF COORDINATION

One SR discussed the effectiveness of coordination between organizations, agencies and bodies providing or financing health services in humanitarian crises (including natural disasters) on health outcomes for affected population. Management and directive coordination was reported to be effective for health system inputs in terms of increased drug availability and medical human resources post cyclone (Akl et al., 2015).

COMMUNICATION AND INFORMATION

One SR reported positive effect of communication and information interventions on improving knowledge and behavioural outcomes. Disaster risk communication interventions (including games, interactive discussion groups or teaching) were reported as an effective means of increasing knowledge and preparedness behaviour (Bradley et al., 2014).

NEGATIVE EFFECT OF INTERVENTIONS

COMMUNICATION AND INFORMATION

Negative effect of communication interventions has also been reported by one SR. The SR established that exposure to print and video media of disasters resulted in negative psychological outcomes for disaster affected population, especially in terms of anxiety reactions (Hopwood & Schutte, 2016).

FACTORS AND ACTORS PLAYING A ROLE

Besides evidence of positive or negative effect of interventions, this evidence summary also sought to study the main factors that contributed to the success or lack of effectiveness of a disaster management intervention, as discussed in the included SRs. The main facilitators include community engagement; coordination and collaboration; communication and information; planning and decision making; resource availability and technical capacity; use of new technologies; country / community ownership; and supporting population characteristics. The main barriers or challenges are in the form of ineffective communication; lack of coordination; logistics; equipment and infrastructure;

insufficient organisational capacity; delays and time pressures; lack of plans and legislation; and lack of understanding of local context.

A multitude of actors perform various, often interconnected, roles during the four stages of disaster management. However, none of the SRs included in the evidence summary explicitly aimed to map the existence of different actors, and their three categories of actors have been identified as having a role in disaster management. Few reviews discussed the role of key stakeholders and broadly three categories of actors have been identified as (i) government and policy makers; (ii) Non-government organisations and aid agencies; (iii) Technical and sector professionals.

CONTEXTUALISATION

Many countries in South Asia have spent millions of dollars improving their response and readiness towards disasters. Consequently, the assessment of the efficacy and effectiveness of the response to disasters is required to ensure that resources are used in the most efficient and effective way. While trying to identify the approaches that can be replicable in other countries, it was noted that not many SRs had a clear focus on LMICs, and none on the South Asian Region. Most of the reviews had mixed or no geographical focus, thus it was difficult to contextualise the findings for South Asia and Bangladesh in particular. Therefore, few of the interventions revealed in the SRs which have been a success in the region or in a country similar to those of South Asia in terms of population, geographical location, culture, livelihood pattern, food habits and demographic conditions (such as Sri Lanka, Thailand, China etc.) have been identified and considered for contextualisation. While the evidence reviewed offers some insights, the paucity of rigorous research on effectiveness of disaster management approaches for South Asia limits the strength of the conclusions. The findings from the SRs considered in the evidence summary which can be replicated in South Asian countries are discussed below:

- **Medical Interventions and Rehabilitation:**
    - These psychological rehabilitation interventions will be especially helpful and effective in resource-poor regions which have few trained mental health professionals.
    - Given the availability of limited health infrastructure in South Asian countries, a community-based approach can be incorporated as part of a comprehensive disaster health management plan.
    - In order to increase acceptances from the community, there is a need to gear the intervention strategies with incorporating cultural norms and traditional beliefs.
- **Mechanisms and Models of Coordination:**
    - Presently, coordination among the organizations and agencies providing medical and health assistance is very low in the South Asian countries leading to inefficiencies, inequity and duplication in the services to the targeted population.
    - There is a need to improve coordination among organizations as it was found out that coordination efforts increased the availability of drugs and manpower and other health response in Bangladesh post 1991 cyclone (Akl et al., 2015).
- **Cash Based Interventions:**
    - Studies found that unconditional cash transfers led to greater improvements in dietary diversity and quality than food transfers.

- It has been identified that local finance institutions can play an important role in implementing and creating awareness about the importance of cash based interventions.
- These institutions can be utilized wisely and meticulously by South Asian countries for implementing this approach as it does not require the creation of additional infrastructure.

- **Capacity, Education and Training:**
  - Children form one of the most vulnerable categories of population at risk with respect to their capacity to prepare for, or respond to, the effects of a disaster.
  - To lessen the vulnerability of children, emergency management agencies, schools and non-governmental organizations have increasingly invested in the disaster education program for children. It produces benefits to children as well as the wider community by enhancing their knowledge base regarding disaster and improved risk perceptions among children.
  - Disaster education, in either addition to a stand-alone curriculum or as an extra-curricular program, can be replicated in the South Asian countries as there is an increasing focus on primary education in these countries.

As most of the reviews included for contextualization lacked geographical focus, country level disaggregation of the findings was not possible in the evidence summary. However, as the objective was to contextualize the findings for South Asia in general and Bangladesh in particular, an attempt has been made to draw from interventions which have been carried out in settings similar to South Asia in terms of population, geographical location, infrastructure, available resources, among others. Given the major challenges faced by Bangladesh for disaster management, the main interventions will be use of community based approaches both for medical and communication intervention, promoting and strengthening school based disaster education, coordination among agencies and cash based interventions through local financial institutions.

GAPS IN EVIDENCE

Medical interventions (mainly on psychological aid) were the most studied disaster management intervention, followed by capacity interventions. There is a paucity of studies which systematically analyse various non-medical interventions in a natural disaster setting. With respect to different stages of disaster management, most reviews focussed on interventions for response execution stage. Most of these systematic reviews did not carry out a quantitative analysis or include a meta-analysis of studies. The outcome which was analysed by most of the reviews (even by non-medical interventions) was health outcomes. Some reviews concluded clearly on evidence for different outcomes, while others provided a narrative conclusion. A large number of SRs did not conclude on effectiveness of an intervention due to insufficient or inconclusive evidence.

The scope of the majority of SRs was not specific to any one of the natural hazards, rather they included a broad category of natural hazards. Also, several reviews included both natural as well as man-made disasters and did not clearly distinguish how the nature of disaster impacted the effectiveness of a particular intervention. Further, more than half of the reviews did not have any geographical focus and included both LMICs and HICs. None of the reviews compared the effectiveness of interventions in HICs and LMICs or within same group of countries with different

contextual factors. Only 10 reviews had a clear focus on LMICs. No review specifically laid focus on the South Asian region or any South Asian country in particular.

However, as none of the included SRs focussed on the South Asian region, there was no clear indication of relatively more investigated and efficient phase of disaster management in this region. A few SRs did, however, include South Asian countries in their synthesis. Out of the SRs that report on positive effect of an intervention, six SRs clearly stated that they included South Asian countries (India, Nepal, Pakistan, and Bangladesh). Interventions for response execution were studied in five of these SRs, recovery in four SRs, risk mitigation in one SR, and response readiness in one SR.

POLICY AND PRACTICE IMPLICATIONS

The systematic reviews included in this evidence summary cover a wide range of interventions but they vary in their approach, size (number of studies included), scope and method of synthesis. Therefore, it is not possible to ascertain which intervention is most effective in managing disasters. There are some implications for policy and practice that can be drawn from the SRs included in this evidence summary.

The role of coordination and collaboration in making an intervention effective has been highlighted especially in cases of medical interventions and capacity enhancement programmes. Collaboration of this kind is needed between different actors, such as non-governmental organizations, service-providers, governments, academicians etc. A more optimal use of new and emerging technologies can assist in better implementation of disaster management programmes especially in case of disaster communication and preparedness.

Participation and ownership from communities is integral to the success of DM interventions in a natural hazards setting. School based disaster education intervention enhances theoretical disaster knowledge; however best results are obtained by combining theoretical and practical activities in school, family, community, and self-education programs. There is a need for a concerted educational drive to achieve disaster preparedness behavioral change.

Communities need to be involved from the beginning, where they play a role in decision making and implementation of interventions, and gear towards mitigating risks of a disaster, planning or execution of a response and recovery. It emerges from the evidence summary that interventions which were sensitive to the sociocultural context and practices of the target region had a more positive impact and wider acceptance. Thus, there is a need to devise necessary and appropriate strategies to counteract exclusion processes in disaster management for inclusive outcomes.

1. BACKGROUND

Natural hazards and their associated risks have continued to occur and are perceived to increase in complexity, magnitude, and frequency, causing major issues to the social-economic-environmental support systems of countries affected. The destructive abilities of natural hazards, together with the vulnerabilities across a range of exposed elements, can lead to large-scale losses in areas with high population and economic investment concentration (Diley et al., 2005). According to International Disaster Database (EM-DAT), natural disasters have caused unprecedented losses over the last decade. In 2010 alone, disasters killed more than 295,000 people, affected over 217,000 others and caused economic damages mounting to US$ 150.9 billion worldwide (Swiss Re, 2011). Economic damages from natural disasters in 2010 were over three times higher than in 2009 (US$ 47.6 billion), and increased by 25.3% compared to the annual average for the period 2000-2009 (US$ 98.9 billion) (Swiss Re, 2011; Guha-Sapir et al., 2010). Between 1990 and 2015, South Asia faced 1792 natural disasters which affected over 2.6 billion lives, resulting in almost one million deaths and about US$ 165 billion worth of damages (EM-DAT, 2016). These totals are, by far, the highest among the recorded disasters in various geographic regions. In 2015 alone, South Asia was the most disaster prone region in the world recording 52 disasters and 14,647 deaths that accounted for a staggering 64 per cent of total global fatalities (UNESCAP, 2015). The South Asia region, which is home to more than 1.7 billion people, has around 400 million people living below the poverty line. This part of the population is highly vulnerable to natural disasters. History also suggests that South Asia is host to almost all kinds of natural catastrophes. This is due to a range of geophysical, socioeconomic and developmental conditions which include long coastlines, a highly variable monsoon system, high tectonic activity, and high poverty both within and outside of urban areas, inequality of wealth, high population densities associated with rapid urbanisation, unplanned and haphazard urban development. There is also a lack of appropriate disaster risk reduction mechanisms and institutional/regulatory frameworks in the countries of the region. The region is already experiencing earthquakes, floods, cyclones, landslides and droughts repeatedly leading to high number of fatalities and economic losses (UNISDR, 2004; WB, 2009; Prabhakar et al., 2015).

The region of South Asia is highly vulnerable to disasters and has experienced earthquakes, floods, cyclones, landslides and droughts repeatedly leading to high number of fatalities and economic losses. On mapping the occurrence of events in the last century, it can be seen that almost all the six countries identified in this project have had six or more of the following natural hazards: drought, earthquake, cold wave, heat wave, flood, landslide, tropical cyclone, convective storm, and forest fires. A country wise and event wise break up is given in **table 1.1.**

Table 1.1: Country wise list of occurrence of events in South Asia[1]

S. No			Number of events (1900-2016)					
	Disaster	Sub-type	Afghanistan	Bangladesh	India	Myanmar	Nepal	Pakistan
1	Drought		6	7	14	--	6	1
2	Earthquake		33	6	31	8	8	30
3	Cold Wave		7	18	29	--	6	3
4	Heat Wave		--	2	25	--	1	14
5	Flood	Flash	19	11	24	3	5	16
6	Flood	Riverine	45	44	145	15	25	42
7	Flood	Coastal	--	2	4	--	--	--
8	Flood	--	22	--	136	7	22	--
9	Landslide	Avalanche	14	--	8	--	5	12
10	Landslide	Landslide	6	4	38	7	21	10
11	Tropical Cyclone		--	87	104	17	--	7
12	Convective Storm		3	35	37	1	3	10
13	Forest Fire		--	--	2	2	2	--

Source: EM-DAT, 2016

While countries have their own disaster management frameworks and South Asian Association for Regional Cooperation has also contributed to the disaster management practices, there remains a lot to achieve in terms of reducing the risks for the large population that resides in this region. The disaster policy planning in the developing countries, especially in the South and South East-Asian countries, seems to be developing under the influence of past significant disaster events. Numerous studies have been undertaken to understand the various approaches for managing disasters and their effectiveness.

The Intergovernmental Panel on Climate Change (IPCC) predicts that due to climate change, heavy precipitation events will increase substantially in the South Asia region (IPCC, 2012). The region has a long coastline of 12,000 kilometres, low lying lands and many islands making it highly vulnerable to cyclones, storm surges, tsunamis and sea-level rise. The heavy precipitation events and projected rising sea levels will greatly impact the coastal areas, especially the heavily populated mega delta regions around Bangladesh, as they will be at greatest risk due to increased flooding from the sea and/or flooding from the rivers (IPCC, 2007). According to the IPCC Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation, Dhaka is in the top thirteen of the most populated cities in the world that are coastal trading hubs and is vital in global supply chains. As Dhaka is also exposed to flooding and storms, it is estimated that exposure of its economic assets is expected to increase from US$ 8 billion to US$ 544 billion between 2005 and 2070 (IPCC, 2012). Another major threat to the region comes from the depletion of Himalayan glaciers,

[1] EM-DAT: The international disasters database. Retrieved from http://emdat.be/guidelines. In the majority of cases, a disaster will only be entered into EM-DAT if at least two sources report the disaster's occurrence in terms of deaths and/or affected persons. Further, at least one of the following criteria must be fulfilled in order for an event to be entered into the database: (i) Deaths: 10 or more people deaths, (ii) Affected: 100 or more people affected / injured / homeless.

threatening the perennial rivers that sustain the food, water, energy, and environmental security of the region. The glaciers which are rapidly receding in the region are also causing increased threats of glacial lake outburst floods (GLOFs) in certain countries like Bhutan and Nepal (Memon, 2012).

It is difficult to identify a single approach to disaster risk reduction in regions like South Asia, which are hit by multiple devastating disasters and characterised by many cultural, social and political distinctions. Yet, there is a growing involvement of regional forums adopting features of disaster risk in its discussions in explicit terms. The South Asia Association for Regional Cooperation (SAARC), considering the value of providing timely relief in humanitarian emergencies and afterwards in reconstruction and rehabilitation, signed an Agreement on Rapid Response to Natural Disaster by member states housed under the SAARC Disaster Management Centre (SDMC) in 2011. However, the agreement is still to be ratified for implementation. The Agreement provides a mechanism to enable member states to adopt a coordinated and planned approach to provide timely relief and humanitarian assistance in emergencies arising out of natural disasters (Ahmed, 2016). The Asian Disaster Preparedness Center (ADPC), a regional resource centre dedicated to disaster reduction for safer communities, supports regional information exchange, networking and capacity building. ADPC provides a range of information and documentation resources on community-based disaster mitigation and flood preparedness among other subjects. International Federation of Red Cross and Red Crescent Societies are contributing in providing disaster education in many countries. They are imparting disaster preparedness information through educating schools and using television and media to convey messages. Local and international NGOS, plus other civil society organisations, have been instrumental in refining and promoting DRM activities, including at the community level (UNISDR, 2005; UNOCHA, 2013). It is also important to point out that a regional response to natural disasters, whether in the shape of the SAARC Framework on Disaster Management or other bilateral and trilateral institutional arrangements that nations may think of, is extremely important for disaster risk reduction.

Increasing frequency of disasters has led governments across the world to start thinking about investing in proactive approaches with preparedness and mitigation towards disaster risk reduction along with the reactive relief centric approach after a significant disaster. There is a growing policy emphasis on knowledge generation and capacity building and also bold and sustained investment in building disaster resilient development infrastructure. Thus, there is an increased focus of governments in making and implementing DRR policies at international, national and local levels, and also making and financing "disaster-risk-smart" development at all levels. However, scaling up programmes, activities and projects to address the underlying risk factors for reducing the risks of disasters have moved at a slow pace due to limited resources and lack of sustained initiatives for mainstreaming and converting presidential ordinances and decrees into law. Increasingly, more South Asian countries are according space to disaster risk reduction in their national development plans (Akanimoh, n.d; Varma et al., 2014; UNISDR, 2014). For example, Bangladesh, with a long experience with severe cyclonic events, floods, land-slides, cyclonic storms and threats of earthquakes and hence realizing the importance of disaster management for protecting the gains of development the country, enacted in November 2012 the Disaster Management Act (DMA). The Standing Orders on Disaster (SOD) provides a detailed institutional framework for disaster risk reduction and emergency management. It outlines detailed roles and the responsibilities of ministries, divisions, departments, various committees at different levels, and other organizations involved in disaster risk reduction and emergency management (GoB, 2010a). The Cyclone Shelter Construction, Maintenance and

Management Policy 2011 was formulated by the government to ensure proper use of the multi-purpose cyclone shelters that have already been constructed, under construction and are to be constructed in the coastal areas (GoB, 2012).

In the past two decades, India's public policy on disaster management has shifted from a focus on relief and rehabilitation efforts to holistic management of disasters. This new policy approach incorporates pre-disaster issues of prevention, mitigation, and preparedness, as well as post-disaster issues of response, recovery, and reconstruction. The Indian government, in 2002, decided to relocate all disaster and risk management issues from Ministry of Agriculture to Ministry of Home Affairs, which is directly responsible for the coordination of the operational aspects of government. It has a wide ranging influence from national policy direction to local implementation of policies. This step reflected a change in the earlier restricted vision of government of associating natural disasters with just concerns of food security (UNISDR, 2005). India has adopted The Disaster Management Act (2005), which provides the legal and institutional framework for disaster management in the country at the national, state and district levels. The act aims to build a safe and disaster resilient India by developing a holistic, proactive, multi-disaster and technology-driven strategy through a culture of prevention, mitigation, preparedness and efficient response (NDMA, 2005). In 2016, India released its National Disaster Management Plan (NDMP). The plan, with its regional approach, provides integration among all agencies and departments of the Government. The plan covers all phases of disaster management and also identifies major interventions to serve as a checklist for agencies responding to a disaster (NDMA, 2016).

The earthquakes in 2005 in northern Pakistan exposed its vulnerability to disaster risks and pushed the government to shift from a response-focused approach to a proactive approach. This shift in the approach in the formulation of National Disaster Management Ordinance (2006) was replaced by the National Disaster Management (NDM) Act in 2010.

The proactive risk reduction approach can be seen in other countries of South Asia too. Nepal has adopted the National Policy Framework for Tenth Plan (2003–2008) and identified disaster management as the core need of sustainable and broad-based economic growth. The plan focuses on disaster risk reduction by enhancing preparedness activities at national and community levels, by engaging local bodies, non-governmental organizations, community organizations, and the private sector (Chakrabarti, 2015).

These represent only a few of the developments that national governments of South Asian countries are progressing and highlight the shifting focus from one post-disaster relief and rehabilitation to holistic management of disasters covering all phases of disasters. Yet there is a lot to achieve in terms of reducing the risks for the large population that resides in this region. Furthermore, the collaboration and cooperation among different stakeholders, including UN agencies, regional and international organisations, civil sectors, private sectors, media and academics is crucial for the effective disaster risk reduction to improve resilience of communities.

1.1 INTERNATIONAL ARENA

In 1987, the General Assembly of United Nations declared the 1990s to be the '**International Decade for Natural Disaster Reduction' (IDNDR)**, with the objective of reducing deaths, property damage, and social and economic disruption caused by natural disasters such as earthquakes, windstorms,

tsunamis, floods, landslides, volcanic eruptions, wildfires, grasshopper and locust infestations, drought and desertification, and other hazards of natural origin, especially in developing countries. As a consequence of the World Conference on Natural Disaster Reduction held in Yokohama, Japan, in 1994 **Yokohama Strategy** and Plan of Action for a Safer World was developed and adopted in the conference. The conference's focus was to review the outcomes of the activities and planning activities for the remaining decade. The strategy is based on 10 principles, which highlight the significance of risk assessment and disaster prevention and preparedness as vital to national planning. It emphasises the role of early warning, need of the participation of communities at risk including each community's most vulnerable people, especially in developing countries. Thus, Yokohama conference induced a shift from not just limiting to a science oriented approach for effective disaster prevention but also to include socioeconomic aspects as they are the main drivers to determining societal vulnerability. When the IDNDR ended in 1999, the UN General Assembly established the secretariat of the United Nations International Strategy for Disaster Reduction (UNISDR) to facilitate the implementation of the **International Strategy for Disaster Reduction (ISDR)** in order to mainstream the focus on vulnerability to hazards and disaster risk into the major policy frameworks.

In 2005, the UN General Assembly convened a second World Conference on Disaster Reduction (WCDRR) in Kobe, Japan, to observe the progress obtained in implementing the 1994 Yokohama Strategy and also to share good practices and lessons learnt. The review of the Yokohama Strategy acknowledged that there is increase, if not universal, in the understanding and recognition among countries that disaster risk reduction is essential for sustainable development. It also emphasised the importance of multisectoral and multi-stakeholder approaches for building resilience, reducing vulnerabilities and hazard impacts through enhancing national and local capacities (UN, 2005).

One of the important outcomes of the WCDRR in Kobe was the adoption of **Hyogo Framework for Action (HFA)** 2005-2015: Building the Resilience of Nations and Communities; a ten year strategy for stronger commitment to the Disaster Risk Reduction (DRR). The framework was adopted by 168 countries shifting the paradigm for disaster risk management from post disaster response to a more comprehensive approach that would also include prevention and preparedness measures. With the adoption of HFA, the United Nations General Assembly tasked UNISDR with supporting its implementation and also monitoring its progress, which is entirely dedicated to DRR. The HFA strived to achieve an expected outcome of substantial reduction of disaster losses, in lives and in the social, economic and environmental assets of communities and countries by 2015 (UNISDR, 2005).

The HFA listed three strategic goals and five priorities of action. The priority areas identified in HFA are cross-cutting for reducing disaster risk: multi-hazard approach, gender perspective and cultural diversity, communities and volunteer participation, capacity building and technology transfer (Shaw et al., 2013). The HFA highlights activities spanning the five priorities: establish global tsunami warning systems; reduce disaster damage; improve healthcare after disaster; set up more early warning systems; strengthen coping mechanisms of community from disasters; develop safe building standards; cost-effective preventative countermeasures; create a global database on relief and reconstruction and a centre on hazards (Twigg, 2007). All these activities are working towards developing preparedness, response, recovery, prevention, and preparedness and mitigation strategies to reduce the risk of disasters. Details of the Hyogo Framework are given in **Appendix 1.1**.

UNISDR also suggested 22 indicators for measuring the compliance with HFA for these five priorities. These indicators have been assessed biennially during the review processes of 2007-2009, 2009-2011 and 2011-2013. The HFA Review process is an entirely voluntary, self-assessment process led and owned by inter-governmental organizations, governments and local government institutions at regional, national and local levels, respectively. The countries rate themselves on a scale of 1-5 (with 1 denoting least progress and 5, the highest progress). It is designed to promote a multi-stakeholder appraisal of the state of disaster risk, of the measures that each government is taking to address risk, and allow an assessment of progress in implementing the HFA (Chakrabarti, 2013; UNISDR, 2015).

The implementation of HFA has resulted in cooperation agreements and joint plans of action in all regions of the world, including one legally binding regional instrument, and in the creation of important tools such as the Global Platform and the Global Assessment Report (UNESCAP, 2011). The period after adoption of HFA at UN WCDRR has been significant in terms of realisation of vulnerabilities of communities. The HFA implemented by different partnerships and collaboration informed more on the concepts of resilience, vulnerability, exposure as components of disaster risks. It has also led to understanding of comprehensive approaches like hazard assessment, vulnerability analysis, and capacity development directly addressing these components (Surjan et al., 2011). The HFA also underscores the relationship between reducing disaster risk and achieving broader development challenges such as the Millennium Development Goals (MDGs) (UNISDR & UNESCAP, 2012).

To accelerate the HFA and other DRR efforts by UN, World Bank established **Global Facility for Disaster Reduction and Recovery (GFDRR)** in 2006 to help the developing countries to understand and reduce their vulnerabilities to natural hazards by enhancing their capacity for disaster prevention, emergency preparedness, response, and recovery. GFDRR is supported by 34 countries and nine international organisations and provides grant financing, technical assistance, training and knowledge sharing activities to mainstream disaster and risk management in policies and strategies (UNISDR, 2008).

The third UN WCDRR in 2015 in Sendai, Japan led to the adoption of **The Sendai Framework for Disaster Risk Reduction (SFDRR) (2015-2030)**, which is the successor to the Hyogo Framework for action (HFA) (2005-2015). The SFDRR is a 15-year, voluntary, non-binding agreement which seeks to bring about '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' (UNISDR, 2015). The SFDRR set out a more ambitious agenda than HFA, builds on the achievements of HFA and was adopted by 187 member states. It calls for a historic shift from an emphasis on disaster management to addressing disaster risk management. It focuses on the underlying drivers of disaster risk, such as poorly planned urban growth in areas subject to flooding, landslides, earthquakes, cyclones, and the effects of climate change. The SFDRR advocates an approach that is people-centred and preventive, and promotes the proactive management of disaster risk over the reactive management of disasters (UN, 2015).

The SFDRR outlined seven global targets and four priority actions to evaluate the global progress towards the framework. The focus of priority actions listed out in the SFDRR includes enhancing the understanding of disaster risk in all its dimensions of vulnerability, capacity, exposure, hazard characteristics, environment; public, private investment in structural and non-structural measures; to strengthen disaster preparedness for more effective response (Wahlström, 2015).

If the SFDRR is to be seen in its totality, the stakeholders have a greater role to play in the disaster risk management and as new avenues of public engagement are developed, there is a need to assess the success of such avenues and use them effectively in disaster management. As part of disaster preparedness, the SFDRR has included early warning systems as one of the seven global targets of disaster risk reduction and further broadened the scope of early warning to include 'people-centred multi-hazard, multisectoral forecasting, disaster risk and emergency communication mechanisms, social technologies and hazard-monitoring telecommunication systems'. The SFDRR has also given substantial attention to health issues in rehabilitation as part of disaster recovery. Member countries have voluntarily committed to find durable solutions in the post-disaster phase to help and empower people affected by disasters. They have also agreed to strengthen capacities for disaster risk management for health. Preparing for a disaster from a health care and safety perspective member countries will also be putting efforts into improving and building resilient health systems, including hospitals. For enhancing recovery from disasters psychosocial support and mental health services are also recommended in the SFDRR (Selmi & Murray, 2015).

The outcomes of each WCDRR (Yokohama, Hyogo, Sendai) conference are the formulation and implementation of policies and measures that are supported by awareness generation, risk assessments, early warning systems and emergency response capacities (Briceño, 2015).

The Intergovernmental Panel on Climate Change (IPCC) has also placed disaster risk reduction at the centre of climate change debate in its publication for policy makers on managing risks of extreme events and disasters. The report provides insights into how disaster risk management and adaptation may assist vulnerable communities to better cope with climate change, and experience of wide range of options to reduce exposure and vulnerability and improve resilience to climate extremes. Options include early-warning systems, innovations in insurance coverage, improvements in infrastructure and the expansion of social safety nets (IPCC, 2012).

Similarly, the **Sustainable Development Goals (SDGs)** have also embedded disaster risk resilience in nine out of its 17 goals for sustainable development. However, several states have called for the need for Disaster Risk Reduction (DRR) to be mainstreamed across poverty reduction, gender equality, education, health, food security, governance, cities, peace and security, agriculture, water and sanitation, energy, ecosystems, and technology transfer.

1.2 EFFECTIVENESS OF POLICIES OR PRACTICES

Disaster management is a relatively new domain of research and has received much attention after a series of natural disasters occurring after 1990s. Although a lot of literature is available as guideline/programs on different approaches to manage disasters fewer studies are available to test the effectiveness of the approaches in the long term outcomes.

Most of the empirical research is in the nature of case studies/descriptive accounts on the effectiveness of disaster management approaches. A few studies reported by the International Federation of Red Cross (IFRC) and Red Crescent Societies demonstrate effective disaster planning, preparation and dissemination of early warning information that led to a minimal death toll in the wake of the strongest cyclone to hit India in 14 years. In mid-October, 2013, Cyclone Phailin swept over the Bay of Bengal and across the eastern coast of India. Early warning alerts, disseminated four days before Phailin struck land, allowed for the evacuation of nearly 1.2 million people (GoO, 2013),

resulting in the largest evacuation operation in India in 23 years (IFRC, 2013). Ganjam and Puri districts were two of the few districts that received special warnings from the OSDMA (Odisha State Disaster Management Authority) on 10 October, two days before the cyclone's landfall, to evacuate those living in mud houses and low lying areas before the morning of 12 October. A total of 21 lives were lost as a result of the cyclone (GoO, 2013) as compared to Cyclone 05B, which hit the same area in 1999, leaving 10,000 people dead. This event exhibits the importance, benefits and effectiveness of the use of early warning for a massive disaster. The United Nations approved of the state's well-functioning disaster risk reduction (DRR) system which includes preparedness activities by families, communities, governments and non-governmental organisations (NGOs). The UN highlighted the state's efforts as a model for disaster management programmes globally (Senapati, 2013). This event exhibits the importance, benefits and effectiveness of the use of early warning for a massive disaster.

In another case, recognizing that children are the most vulnerable group when a natural hazard strikes, Bangladesh started a disaster risk reduction campaign entitled "Know Risk = No Risk", embarking on promoting disaster reduction education. A Learning Kit for children on Disaster Risk Reduction (DRR) was developed and adapted to local contexts and language. The learning kit was the first DRR learning material in the Bangla language that aimed to help children learn about disaster risk and take actions for risk reduction. This work is carried out under the leadership of Disaster Management Bureau (DMB) of Bangladesh Government on the campaign -Disaster Risk Reduction Begins at School. The initiative can be considered good practice because: (1) the learning kit was in the national language, which facilitated understanding and helped reach the largest number of people; (2) the kit, especially through the games, focused the students' attention in a fun and relaxed way, which made understanding and learning very easy (as reflected by students' comments above); (3) teachers and parents have been invited to use the kit to help children learn about disaster risks and help reduce disaster risk (UNISDR, 2007).

As stated by Haque et al. (2012) cyclone-related fatalities in Bangladesh has decreased manyfold over the past 40 years, from 500,000 deaths in 1970 to 4,234 in 2007. This can be seen for example during the Cyclone *Sidr* that drew near the country in 2007, in which approximately 4,500 people died compared with 138,000 during one of similar intensity in 1991. The author has attributed this decline in fatalities and injuries to improved defensive measures, including early warning systems, cyclone shelters, evacuation plans, coastal embankments, reforestation schemes and increased awareness and communication although he states a lack of scientific evidence at present of the impact of these measures on mortality.

1.3 RESEARCH BACKGROUND

The discourse on disaster management has been evolving for nearly three decades now. As mentioned above in the section on 'Effectiveness of policies or practice', this field received greater attention following a series of natural disasters which occurred after the 1990s. The literature on disaster management is varied and extensive. Most of the empirical research is in the nature of case studies/descriptive accounts on the effectiveness of disaster management approaches.

Systematic reviews of disaster management approaches are fairly new and still emerging. Some of these reviews are in the nature of a literature review or are still at the stage of protocol. These reviews have looked at a range of disaster management approaches such as medical rehabilitation, emergency

public health infrastructure, cash based intervetnions and community based disaster management. These cover different stages of the disaster management (risk reduction, readiness, relief and recovery), depending upon the intervention being reviewed.

WHO (2013) carried out a systematic review of Public Health Emergency Operation Centres (EOCs) to identify global best practices for effective public health emergency response, to identify indicators to monitor EOC performance, to describe risk communication in EOC settings, to outline research needs and to identify standardised terminology. According to the review, EOCs provide support to on-scene response and relief activities. Although the format, structure, and size of individual EOCs vary widely, their role in public health emergency management and response is universally fundamental.

A systematic review by Khan et al. (2015) focused on effectiveness of medical rehabilitation intervention in case of natural disaster. It was found that there is a need to incorporate medical rehabilitation into response planning and disaster management for future natural catastrophes. According to the authors, access to rehabilitation and investment in sustainable infrastructure and education are crucial and more methodologically robust studies are needed to build evidence for rehabilitation programs, cost-effectiveness, and outcome measurement in such settings (Khan et al., 2015).

Heidaranlu et al. (2015) evaluated the effectiveness of hospital disaster preparedness tools. They concluded in the review that existing tools are weak and there is a need to develop reliable and valid tools by using experts' knowledge and experience through the processes of tool development and psychometric evaluation.

In another review, Horita et al. (2013) assessed the current state of research in the use of Volunteered Geographic Information (VGI) and Crowdsourcing as a source of information to aid the management of disasters. The results suggest there is an increasing body of knowledge of VGI and the way it can improve disaster management. It also reveals gaps in the use of VGI in the research areas of 'preparedness' and 'recovery', as well as the need for more robust case studies and experimental research to support this promising field. Bradley et al. (2014) carried out systematic review to identify, analyse and synthesize the effectiveness of risk communication interventions during four stages of disaster cycle. They found mixed impact of various risk communication interventions. Some interventions appeared to have improved preparedness and mitigation behaviour while some robust evidence was present in case of recovery and response phase. Most importantly, one intervention was found to have resulted in an undesirable reduction in protection behaviour by the people.

Some of the systematic reviews are not yet completed and are in the protocol stage. These were excluded from the evidence summary as we reviewed only the completed systematic reviews to draw from past experiences which can be contextualised in case of South Asian countries. Nevertheless, it is valuable to discuss these protocols here as they provide insights into the kind of disaster management interventions being reviewed and studied. Zwi et al. (2013), through systematic review are trying to evaluate how, why and under what circumstances community based disaster management initiatives reduce the social and economic impact of disasters. The major objective of the study is to find out the factors, which led to such reduction and develop a theory, which can be contextualized in the case of lower and middle income countries. In another protocol, Munroe et al. (2012) focus on how the ecosystem based approaches help people to adapt to climate changes. The objective of the review is to identify the existing gaps in the literature regarding effectiveness of such

approaches and suggest for further research. This will enable the policymakers to take an informed decision by comparing the effectiveness of these ecosystem-based approaches with other approaches. Yates et al. (2015) will assess the effectiveness of short-term hygiene interventions in case of emergency situation on use of health services, cost effectiveness of intervention, health and non-health related outcomes.

2. ABOUT THE EVIDENCE SUMMARY

2.1 OBJECTIVE AND RESEARCH QUESTIONS

The South Asia Research Hub (SARH), DFID, has launched a Systematic Review (SR) Programme for South Asia. The programme aims at providing DFID country offices, policy-makers and development practitioners in South Asia with a robust assessment of the evidence base for their policies and programmes. To this effect, inter alia, it commissioned preparation of Evidence Summary on Effects of Various Disaster Management Approaches.

The aim of this Evidence Summary was to review and summarise review-level evidence on the effectiveness of disaster management approaches in low and middle income countries, and contextualise that evidence for the South Asian region.

The primary review question for the evidence summary was:

- What are the review-level effects of different types of Disaster Management approaches?

The findings of the evidence summary were contextualised at two levels - firstly, for the South Asian region as a whole (covering countries – Afghanistan, Bangladesh, India, Nepal, Pakistan and Myanmar); and secondly, specifically to Bangladesh.

The sub questions that guided this exercise included:

i. What are the different approaches for each phase of the disaster (prevention, preparedness, relief, rehabilitation) management?

ii. What are the effects of different types of Disaster Management approaches (both regional and country level?

iii. What are the factors that contributed to the success (or lack of success) of an approach in managing a particular disaster/s?

iv. What are the different actors (public, private, volunteer, international) involved in different approaches which are effective in managing the disasters?

v. Which approaches will be relevant for the South Asian region (covering countries – Afghanistan, Bangladesh, India, Nepal, Pakistan and Myanmar)?

vi. What characteristics are embedded in approaches that are found to be replicable in other countries/regions?

vii. Which phase of disaster management has been relatively more investigated and efficient in the South Asian Region?

2.2 METHODOLOGY AND APPROACH

A number of steps, which are typically used in conducting a systematic review, were followed in preparing this evidence summary. The primary steps were conceptualisation, identification of studies (search, screen), appraisal and data extraction, synthesis, and contextualising.

A research protocol was prepared and adhered to for every step of this Evidence Summary. The research protocol was finalised after extensive discussion with the reviewers, advisors and the South Asia Research Hub (SARH) consortium.

CONCEPTUALISATION

This section outlines and defines the key concepts addressed in this review. A list of definitions of key terms is given in **Appendix 2.1.** The conceptual framework discussed below informed the search terms, inclusion criteria and the synthesis of findings.

DISASTERS AND AFFECTED POPULATIONS

Disaster can be understood as an event that causes extensive damage to individuals and their environments. Although disasters can be either natural or man-made disasters (e.g. war, terrorist attacks, etc.), the focus of this evidence summary are disaster classified as 'natural'. Various disasters have occurred in South Asian region, (as document according to countries previously outlined country wise break up of incidents in table 1.1. With particular reference to natural disasters that occur in the South Asian region, the evidence summary included the following natural hazards:

- Drought
- Earthquake
- Cold Wave
- Heat Wave
- Flood
- Landslide
- Tropical Cyclone
- Convective Storm
- Forest Fire

Volcanoes were not included in the scope of this evidence summary as no major incidence of volcano related disaster has occurred in the South Asian region in the last century.

In this evidence summary, we are interested in reviews which target their response to all populations affected by natural disaster. Whether an intervention was delivered at the whole population level or addressed specific concerns at a community or individual level, it was included in this review.

DISASTER MANAGEMENT INTERVENTIONS

Disaster management and disaster risk reduction are interventions that seek to mitigate and address the impact of disasters. They are most usefully analysed, not as an end point in themselves, but as a

cyclic process, with the end of one phase marking the start of another (**Figure 2.1**). These phases of disaster management have been relatively well documented in the literature (Vasilescu et al., 2008; Twigg, 2015). This approach has been integral to the evidence summary to support a greater understanding of the types of interventions that have been systematically reviewed according to each phase.

Figure 2.1: Key phases of disaster management interventions

Source: Adapted from Posner and Dransch, 2010

The main elements of this process are the **four 'R's**: **Risk mitigation** (disaster prevention), **Response readiness** (disaster planning and preparedness), **Response execution** (disaster relief) and **Recovery** (disaster recovery). These 4 'R's illustrate measures by which public and private institutions, corporates, civil society, and communities attempt to reduce the impact of disaster or react during and immediately after a disaster, followed by the steps to recover from a disaster after it has occurred. Timely actions during each phase of the cycle result in greater preparedness, better warnings, reduced vulnerability and prevention of future disasters. The four 'R's do not always, or generally, take place in isolation. They often overlap in the cycle with their duration greatly depending on the severity of the disaster.

Risk mitigation involves eliminating or reducing the probability of disaster occurrence or steps to reduce vulnerability from unavoidable disasters taken before a disaster occurs. Examples of interventions or strategies might involve vulnerability analyses, changes in building codes to fortify building and revised zoning, land use management, strengthening of infrastructure, preventive health care.

Response readiness (e.g. planning and preparedness) is usually designed to enable governments, organisations, communities and individuals to respond rapidly and effectively to disaster situations. This includes interventions such as early warning systems, emergency communications, public education and awareness, training programs, including exercises and tests.

Response execution/Relief is a coordinated multi-actor response to reduce the impact of a disaster and its long-term results. This includes search and rescue, provision of emergency food, shelter, medical assistance, survey and assessment, and evacuation measures.

Disaster management approaches (interventions) and the corresponding outcomes were located within 4 Rs of disaster management based on the information provided in a systematic review. The phases, interventions and outcomes often overlapped. The section on findings and synthesis delves into details of this categorisation and overlaps.

STUDY DESIGN

The evidence summary will summarise and synthesise findings from systematic reviews only. It adopts a very broad definition of systematic review and includes any completed study (not a protocol) that has systematically searched at least two databases in review and specified a clear inclusion and exclusion criteria.

SEARCH STRATEGY

The team conducted a comprehensive search electronically to identify published systematic reviews (SRs). It included only those studies for which at least abstracts were available in electronic form. All relevant documents meeting search criteria were catalogued in EPPI-Reviewer 4. EPPI-Reviewer 4 was used to export citations, remove duplicates and manage the screening and review process.

Search was conducted in four categories of sources: (i) Electronic databases, (ii) Specialist databases for SRs, (iii) Specialist websites on disaster and climate, (iv) Websites of relevant organizations. The list of sources was finalised based on comments and feedback from QAT and review team comprising experts on searching methodologies (**Appendix 2.3**). Depending on the nature and interface of these sources, different approaches were used for searching bibliographic databases, review sources and topic websites.

Search terms were selected based on the PICOS and categorised into a) Study design, b) Phenomenon, c) Intervention. These were subsequently reviewed by experts and the review team, and pilot tested. Final search terms used are listed in **Appendix 2.4**.

Although the scope of the evidence summary is restricted to systematic reviews, the search included terms like meta-analysis, meta ethnographic, evidence synthesis, literature review etc. to ensure that any review that meets the criteria of a SR, but does not use the term ‘Systematic Review’, is also reflected in the search.

Every search was carefully designed to include all these concepts to ensure that the electronic search was comprehensive and yet showed most relevant results. The preliminary search string was developed using Boolean operators and with inputs from investigators and subject experts. The search

strategy was run onto a few databases and improved further iteratively based on the results of the pilot search. With the help of expert advice from EPPI-Centre regarding the suitability of the developed search strategy, the search strings were revised and sets were created for each of the concepts (A, B and C) mentioned above.

SCREENING OF STUDIES

A two-stage screening process was adopted to select systematic reviews. The first stage involved screening of all titles and abstracts for eligibility based on a predefined inclusion and exclusion criteria (**Appendix 2.6**). This screening was done by two researchers and any disagreement was resolved by a third researcher. In the second stage, retrieved full text articles were independently screened by researchers against a checklist of inclusion criteria.

The inclusion and exclusion criteria were derived from the review question and the PICOS: population, intervention, comparison, outcome, and study design. Further additional parameters were added to determine inclusion in the evidence summary. Details of the PICOS are given in **Appendix 2.2**.

All systematic reviews, which met the following criteria, regardless of country origin of natural disasters were included:

1. **Language:** published in English.
2. **Year of publication:** published in 1995 or later.
3. **Region/Country**: regardless of country origin of natural disasters.
4. **Study Design**: met the following methodological criteria: systematically search at least two databases in review and specify inclusion and exclusion criteria clearly.
5. **Phenomenon:** disasters or natural hazards that occur in the South Asia region (drought, earthquake, cold wave, heat wave, flood, landslide, tropical cyclone, convective storm, forest fire).
6. **Disaster management interventions –** synthesis of evidence on any type of disaster management intervention. These interventions could occur at different stages of a disaster: risk reduction, response, relief and recovery.

Systematic reviews were not excluded according to comparisons or outcomes reported in the primary studies of included reviews. However, consideration was given to them in the synthesis to the extent possible.

Full text screening was done based on smaller inclusion criteria comprising only study design and intervention. (**Appendix 2.6**)

CHARACTERISING AND DATA EXTRACTION

Reviews which met the inclusion criteria were identified and described based on the information contained in the stages of disaster management, type of natural hazard, key interventions, outcomes of the intervention mentioned in the systematic review, study design, geographical locations,

bibliographic details (e.g. Authors/date), populations targeted, the aim and the number and types of studies included in SRs, and synthesis statements included in the review about effectiveness. These were integral in informing the narrative evidence summary. Data from SRs was extracted in EPPI-Reviewer based on the criteria given in **Appendix 2.7**.

QUALITY APPRAISAL

The team used the tool 'A MeaSurement Tool to Assess systematic Reviews' (AMSTAR) to evaluate quality and decide whether or not a particular review should be used in the evidence summary. The ability to evaluate the quality and reliability of systematic reviews was imperative in this process. The team used the items detailed in AMSTAR to demonstrate the aspects of systematic review methodology that influence the overall quality of a review. It comprised 11 concise criterion items, and each item was given a score of 1 if the specific criterion was met, or a score of 0 if the criterion was not met, was unclear, or was not applicable. An overall score relating to review quality was then calculated (the sum of the individual item scores). AMSTAR characterises quality at three levels: 8 to 11 is high quality, 4 to 7 is medium quality, and 0 to 3 is low quality. Amstar tool is given in **Appendix 2.8**.

SYNTHESIS

Qualitative narrative synthesis was carried out for this evidence summary. Reviews, which were characterised as high quality or medium quality in the appraisal, were included in the synthesis. Synthesis was done in light of the research questions listed earlier in the report. The analysis was also guided by the PICOCS, where possible and relevant.

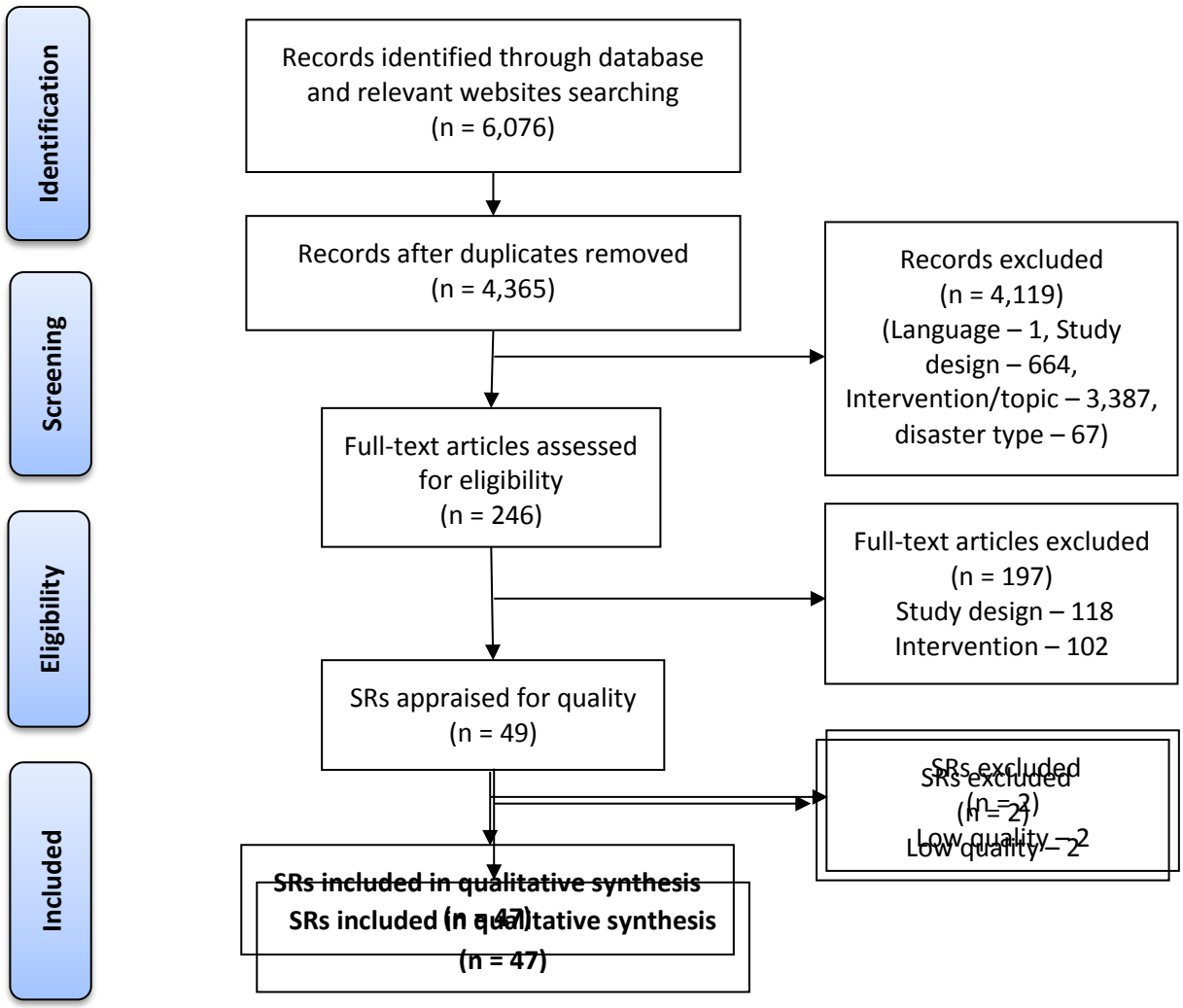
3. EVIDENCE SUMMARY

Out of 4365 results, 49 full text documents met the two stage inclusion criteria. After quality appraisal, 47 high and medium quality systematic reviews were included in the synthesis. A narrative synthesis was conducted detailing the SRs. The SRs investigated a range of different interventions and outcomes across the four stages of disaster management outlined in the conceptual framework.

3.1 KEY FINDINGS

The database and websites search identified 4,365 results after removal of duplicates. Titles and abstracts of these results were screened on a pre-determined inclusion and exclusion criteria of language, study design, intervention and disaster type (**Appendix 2.6**). A total of 246 documents met the first stage inclusion criteria.

Figure 3.1: Results of screening on title/abstract and full text



At the stage of full text screening, 118 reviews were excluded as they did not satisfy the definition of a SR[2]. Further, 102 reviews were excluded as they did not study a disaster management intervention. Twenty-three reviews did not meet the double criteria of study design as well as intervention. After screening of full text articles, 49 reviews were included. After quality assessment, 47 reviews were found to be of medium or high quality, and were included in the evidence summary and synthesis. (**Figure 3.1**)

CHARACTERISITICS OF INCLUDED REVIEWS: AIM, DATE AND STUDY DESIGN

A little over half of the included documents (26 reviews) reviewed the effectiveness of disaster management interventions, including the impact of a DM intervention on a particular outcome. 22 systematic reviews aimed to synthesise DM interventions more generally, examining the various aspects of an intervention, including its use and strategies of implementing the intervention. Barriers or facilitators in a DM intervention were reviewed by eight documents. Three documents provided a scoping review of DM interventions and eight had a clear objective to review research in this area. Several were mixed methods reviews and had more than one objective.

The search and screening process included reviews published only post 1995. However, most reviews that met the inclusion criteria had been published in the last three years, i.e. since 2014, 2015 or 2016 with only 14 SRs published prior to 2014. The earliest review which has been included in the synthesis was published in 2004.

All the reviews that have been included in the evidence summary fall within the definition of a 'systematic review' as defined in the conceptual framework of this evidence summary. However, not all reviews have been called systematic reviews. They are identified as SRs, systematic literature review, evidence review, integrative review, methodological review, systematic search, meta-analysis, meta-review, scoping review and review. The majority of the reviews provided a narrative synthesis (78%), followed by numerical synthesis (8%) and meta-analysis (10%). Two reviews did not conduct a synthesis, as they were empty reviews.

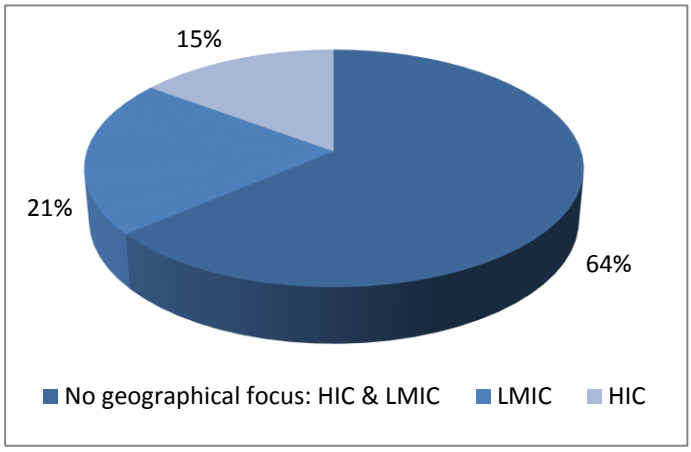
The size of the systematic reviews, in terms of number of studies included varied greatly. As stated, two were empty reviews, four reviews included less than 10 studies, 17 reviews included 10 to 20 studies, and 16 reviews included 21 to 40 studies. Approximately eight reviews reported results from over 40 studies. The type of studies included was not clearly reported in 16 reviews. Out of the remaining 31 SRs, some were limited to RCTs, while others included a broad range of quantitative, qualitative studies, quasi experimental designs, and reviews.

[2] A review that meets the following methodological criteria: systematically search at least two databases in review and specify inclusion and exclusion criteria clearly

GEOGRAPHICAL CONTEXT OF INCLUDED REVIEWS

Of all the reviews included in the evidence summary, 30 did not have any geographical focus and included Low and middle income countries (LMICs) as well as High income countries (HICs). Only 10 reviews had a clear focus on LMICs and seven reviews had a focus on HICs. **(Figure 3.2)**

Figure 3.2: Geographical context of included reviews*



**mutually exclusive*

The 10 reviews that focus exclusively on LMICs cover the countries mentioned in table 3.1.

Table 3.1: Countries included in reviews with a focus on LMICs

Author	**Countries included**
Becker et al. (2016)[4]	Brazil, China, Gambia, Ghana, Guatemala, Haiti, India, Indonesia, Mexico, Republic of Congo, Romania, Sierra Leone, Tanzania, Thailand, Togo, Turkey, Uganda
Khan et al. (2015)[24]	China, India, Sri Lanka
Lipinski **et al.** (2016)[26]	Sri Lanka, India, Thailand
Pega et al. (2015)[31]	Not specified/ Not clear
Sadeghi-Bazargani et al. (2015)[33]	Iran
Doocy & Tappis (2016)[37]	Not specified/ Not clear
Soltani et al. (2014)[38]	China, Indonesia, Turkey
Shawn et al. (2012)[43]	China, India, Tanzania, Vietnam, Ethiopia, Kenya, Malawi, Morocco
Zhong et al. (2014)[46]	China
Scott et al. (2015)[47]	Not specified

Thirty reviews did not have a geographical focus, and included a HIC as well as LMIC studies from Asia, Africa, Europe and Latin America. However, several of these reviews did not clearly report which LMICs they included in their analysis.

None of the reviews took an exclusive South Asia focus. However, South Asian countries were included in several reviews. Most of them included India and Nepal. Only two reviews included studies on Bangladesh, one review included Pakistan, and one included Afghanistan.

NATURAL HAZARDS AND DISASTER MANAGEMENT PHASES

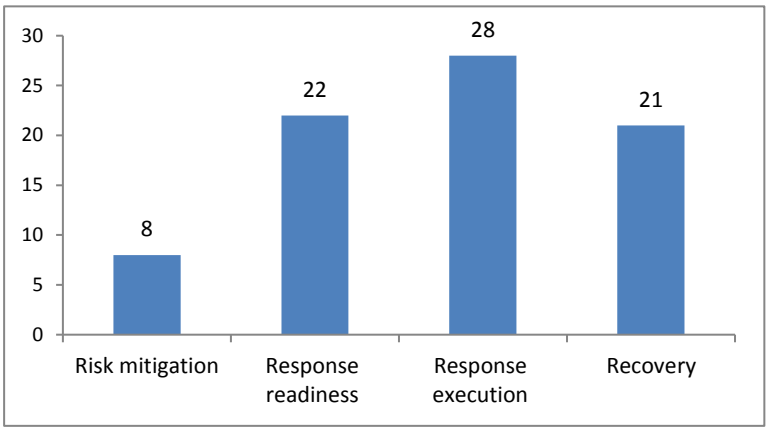
Out of 47 reviews, 31 reviews did not focus on any specific natural hazard, but instead included a broad category of all natural disasters. Many reviews focussed on multiple disasters – 15 reviews looked at earthquakes, nine at floods, six at hurricanes, five at tsunamis and four at heat waves. No review looked at an intervention in the context of cold waves. **Table 3.2** gives a breakdown of the number of reviews across all types of disaster and the corresponding stages of disaster management.

Table 3.2: Number of natural hazards across stages of disaster management included in reviews

	Number of reviews			
Natural Hazard	Risk mitigation (disaster prevention)	Response readiness (disaster planning and preparedness)	Response execution (disaster relief)	Recovery (disaster recovery)
Floods	2	3	6	4
Landslide	1	1	1	0
Cyclone	0	0	1	1
Convective Storm	2	1	2	0
Forest fire	1	1	1	1
Drought	1	1	1	1
Earthquakes	2	7	9	8
Cold Wave	0	0	0	0
Heat Wave	2	1	1	1
Hurricane	0	2	4	4
Tornado	0	1	0	1
Tsunami	0	1	3	4
Not specified	5	17	21	12

Disaster management interventions and outcomes for response execution (relief) were reviewed in 28 reviews. This was followed by response readiness (preparedness) and recovery in 21 reviews each. The least number of reviews (n = 8) covered interventions for the first stage of disaster management, i.e. risk mitigation or reduction. **Table 3.3** and **Figure 3.3** depict the instances of the four Rs being covered in reviews.

Figure 3.3: Number of reviews for each phase of disaster management (4 Rs)*



*not mutually exclusive

Disaster management interventions in SRs span one or more disaster management phase. Some categories of DM intervention, such as communication and information; and capacity, education and training were reviewed for all the four Rs of disaster management. **Table 3.3** gives a breakdown of interventions across the four Rs in the SRs.

Table 3.3: Four Rs of disaster management and DM interventions in reviews*

DM Phase	DM Intervention	No. of reviews
Risk mitigation	• Adaptation measure • Capacity, education and training • Communication and information • International Humanitarian Assistance	**8**
Response readiness	• Behavioural theories and models • Capacity, education and training • Communication and information • Community based management • Crisis management • Emergency Management and Infrastructure • Health systems approach • Healthcare • Insurance • International Humanitarian Assistance • Preparedness tools and guidelines • Strategies to manage and allocate scarce resources	**22**

DM Phase	DM Intervention	No. of reviews
Response execution	• Capacity, education and training • Cash based interventions • Communication and information • Community based management • Crisis management • Emergency Management and Infrastructure • Health systems approach • Healthcare • International Humanitarian Assistance • Mechanisms and models of coordination • Medical interventions and Rehabilitation • Relocation • Reporting and monitoring • Strategies to manage and allocate scarce resources	**28**
Recovery	• Capacity, education and training • Cash based interventions • Communication and information • Community based management • Emergency Management and Infrastructure • Health systems approach • Healthcare • International Humanitarian Assistance • Mechanisms and models of coordination • Medical interventions and Rehabilitation • Relocation • Reporting and monitoring	**21**

*not mutually exclusive

INTERVENTION AND OUTCOMES

This synthesis of review-level evidence is organised by focus of disaster management interventions. The included reviews span a number of disaster management interventions. Every SR, irrespective of its objective and study design deals with one specific disaster management intervention. These include medical interventions (n= 11); Capacity, education and training (n= 6); Emergency Management and Infrastructure (n= 5); Communication and information (n= 3); Preparedness tools and guideline (n= 3) etc. All the interventions are listed in **table 3.4**.

The main outcomes linked to these interventions, as reported in the reviews (number of reviews in brackets), are: Behaviour change outcomes (n=4); Efficient public health emergency services (n= 2); Health outcomes (n= 21); Improved capacity to manage disaster risk & post disaster impact (n= 9); Improved disaster prevention and management infrastructure (n= 2); Knowledge outcomes (n= 5); Reduced risk and vulnerability of disaster (n= 4); Socio economic outcomes (n= 5); Other sector specific outcome (n= 1)

As mentioned earlier, not all reviews aimed at finding evidence of effectiveness or impact on outcome. Thus, seven reviews do not report on any outcomes but discuss the current status, features of an intervention and explore influencing factors. The interrelationship between interventions and outcomes is illustrated in figure 3.4 and discussed in the subsequent section.

3.2 QUALITY OF EVIDENCE

The quality of the included reviews was assessed using AMSTAR checklist. The checklist contained 11 standard questions and the final score was then given to all the reviews based on these questions. Out of the 49 included reviews, 21 attained a score of 8 to 11 and were ranked high quality. Similarly, 26 reviews were reported to have a medium score of 4-7 and lastly, two reviews had a score lower than 4. These two reviews were not included in the evidence summary and synthesis.

The included reviews were also assessed, if they answered the questions –

- Was a comprehensive literature search performed?
- Were the characteristics of the included studies provided?
- Was the scientific quality of the included studies assessed and documented?

21 reviews met the criteria of answering the aforementioned three questions. Out of these 21, 19 reviews already belonged to the "high quality" category and the remaining two to the "medium quality" category.

From all 49 reviews, only 21 reviews had an already published protocol. All but two reviews did not perform a comprehensive literature search. Further, 19 reviews did not search for grey literature. Even though 46 of the 47 reviews provided the characteristics of the included studies, only 21 studies assessed and documented scientific quality of the included studies. (**Refer to appendix 2.9** for a breakdown of the quality appraisal judgements.)

3.3 OVERVIEW OF REVIEW-LEVEL EVIDENCE

DIFFERENT DISASTER MANAGEMENT APPROACHES AND THEIR OUTCOMES

This section seeks to answer the following research questions:

i. What are the different approaches for each phase of the disaster (prevention, preparedness, relief, rehabilitation) management?
ii. What are the effects of different types of Disaster Management approaches (both regional and country level?

This section first maps and summarises the evidence in terms of interventions for different phases, and corresponding outcomes. Thereafter, each intervention with evidence of effectiveness with respect to outcomes is discussed.

The main approaches or interventions for disaster management, as covered in the reviews, are tabulated in **table 3.4**. The table also marks the phase of disaster management that each intervention covers and the total number of reviews for each intervention. In this evidence summary, it was found that medical intervention was the most studied intervention with 11 reviews, followed by capacity,

education and training at six reviews, and emergency management and infrastructure at five reviews. All the interventions discussed in SRs included are elaborated upon in **Appendix 3.1**.

Table 3.4: Disaster management (DM) approaches for different DM phases in systematic reviews

Intervention	Risk Mitigation	Response readiness	Response execution	Recovery	No. of SRs
Medical interventions and Rehabilitation			x	x	11
Capacity, education and training	x	x	x	x	6
Emergency Management and Infrastructure		x	x	x	5
Communication and information	x	x	x	x	3
Preparedness tools and guidelines		x			3
Adaptation measure	x				2
Cash based Interventions			x	x	2
Community based management		x	x	x	2
Healthcare		x	x	x	2
Relocation			x	x	2
Reporting and monitoring			x	x	2
Behavioural theories and models		x			1
Crisis management		x	x		1
Health systems approach	x	x	x	x	1
International Humanitarian assistance	x	x	x	x	1
Insurance		x			1
Mechanisms and models of coordination			x	x	1
Strategies to manage and allocate scarce resources		x			1
Total					47

Note: X denotes the phase of DM intervention in which an intervention has been studied in one or more SRs.

The disaster management interventions have different impacts and outcomes. The same intervention can have different, and multiple, outcomes in different contexts or disasters. Out of the 47 reviews included in the synthesis, seven did not report on any outcomes. The remaining 40 reviews discussed interventions in relation to one or more outcomes. **Table 3.5** summarises the outcomes studied for each intervention and also highlights the LMIC countries reported in the study. The outcome which was analysed by most of the reviews (even by non-medical interventions) was health outcomes. **Table**

3.7 gives a Summary of Findings (SoF) for those SRs which provided conclusive evidence of effectiveness of an intervention.

Table 3.5: Outcomes of different disaster management interventions

Intervention	Outcomes reported	LMICs, where reported
Adaptation measure	Health outcome (1)	Unspecified east Asian countries, Asia, Latin America, Africa
	Improved infrastructure[3] (1)	
Behavioral theories and models	Behaviour change (1)	China, India
	Reduced risk and vulnerability (1)	
Capacity, education and training	Knowledge outcome (3)	Iran, South Africa, Turkey, Tajikistan, India, Nepal, Unspecified Asia
	Improved capacity[4] (4)	
	Behaviour change (2)	
	Reduced risk and vulnerability (1)	
Cash based Interventions	Health outcome (1)	Thailand, Sri Lanka, Indonesia, India, Maldives, Bangladesh, Pakistan, Philippines, Afghanistan, Haiti, Mozambique, Burkina Faso, Chad, Mauritania, Niger, Lesotho, Somalia
	Improved capacity (1)	
	Socio economic outcome (2)	
	Other sector specific outcome (1)	
Communication and information	Health outcome (1)	Iran, India
	Behaviour change (1)	
	Reduced risk and vulnerability (1)	
	Knowledge outcome (1)	
	None reported (1)	
Community based management	Health outcome (1)	El Salvador, Indonesia, Mexico, China, Thailand, Sri lanka, Maldives, India, Bangladesh
	Improved capacity (1)	
Crisis management	None reported (1)	Iran
Emergency management and infrastructure	Improved capacity (1)	China, Iran, Turkey
	Efficient public health emergency services (1)	
	None reported (3)	
Health systems approach	Health outcome (1)	
	Socio economic outcome (1)	
Healthcare	Health outcome (1)	China
	Efficient public health emergency services (1)	
Insurance	Socio economic outcome (1)	China, India, Tanzania, Vietnam, Ethiopia, Kenya, Malawi, Morocco, Ethiopia
International humanitarian assistance	None reported (1)	

[3] Improved disaster prevention and management infrastructure
[4] Improved capacity to manage disaster risk & post disaster impact

Intervention	Outcomes reported	LMICs, where reported
Mechanisms and models of coordination	Health outcome (1)	
Medical interventions and rehabilitation	Health outcome (11) Improved capacity (1) Socio economic outcome (1)	Brazil, Turkey, China, Indonesia, Kosovo, Lebanon, Nepal, Turkey, Sri Lanka, India, Thailand, Haiti
Preparedness tools and guidelines	Improved capacity (1) Improved infrastructure (1) None reported (1)	
Relocation	Health outcome (1) Reduced risk and vulnerability (1)	Mozambique, Papua New Guinea, Philippines, China, India, Indonesia, Vietnam, Armenia, Thailand, Nicaragua, Mexico, Turkey
Reporting and monitoring	Health outcome (1) Knowledge outcome (1)	
Strategies to manage and allocate scarce resources	Health outcome (1)	Mexico, Haiti, Asia

Note: Number of reviews reporting on the outcomes in brackets

EVIDENCE OF EFFECTIVENESS

As mentioned in section 3.1 only 26 out of 47 SRs aimed to review the effectiveness of a disaster management intervention, including impact of a DM intervention on a particular outcome. Most of these systematic reviews did not carry out a quantitative analysis or meta-analysis of studies included in them. Some reviews conclude reporting clearly on evidence for different outcomes, while others provide a narrative conclusion.

For the purposes of synthesis, the evidence on effectiveness as reported in SRs was classified into the following groups:

(i) Positive evidence of effect: Where SRs included a clear synthetic statement (qualitative and quantitative) about positive effect of an intervention, based on the studies included in the SRs;

(ii) No evidence of any difference: Where SRs did not report any noticeable difference in outcomes before and after an intervention;

(iii) Evidence of harm: Where SRs included a clear synthesis statement about negative or adverse effect of a particular intervention;

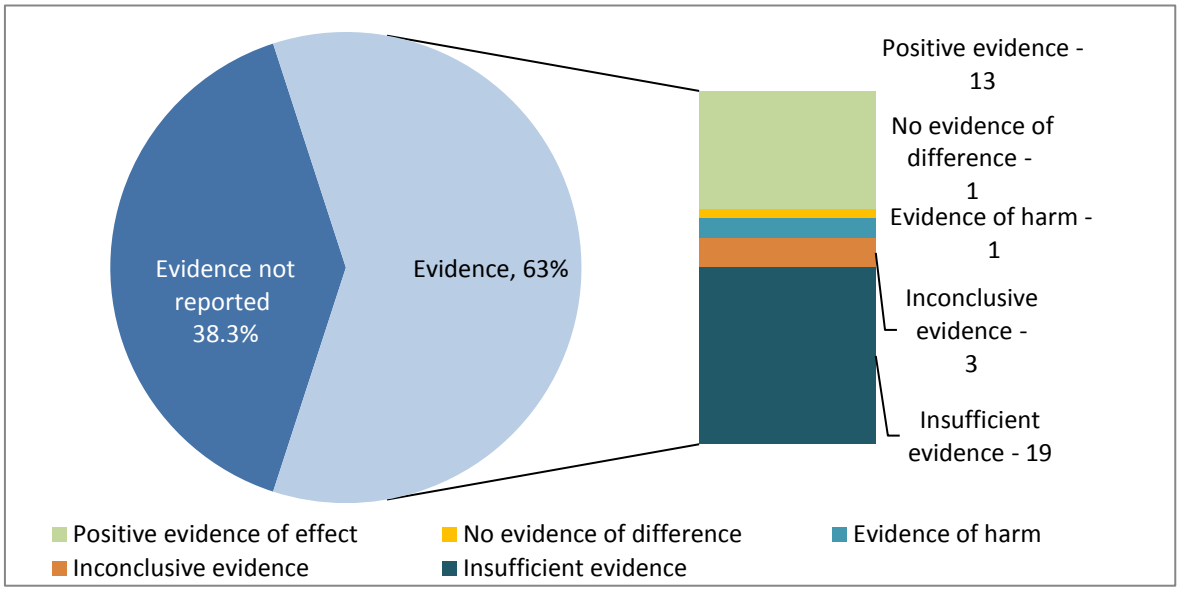
(iv) Inconclusive evidence: Where SRs could not determine or state conclusively whether an intervention was effective or not, and

(v) Insufficient evidence: Where SRs state that the evidence was insufficient to link interventions to a positive (or negative) effect.

This Evidence Summary reports on SRs, which themselves contain different kinds of evidence on different outcomes. Forty seven SRs were included for synthesis[5]. Out of the 47 SRs, seven SRs did not report on any outcome. The remaining 40 SRs reported on a total of 60 outcomes. Since many SRs dealt with more than one outcome, they provided different conclusions and evidence for each outcome. Some reviews reported multiple outcomes for a single intervention.

Out of the 60 reported outcomes, evidence was reported for 37 outcomes. Within these 37 outcomes of evidence, positive evidence of effectiveness was provided for 13 outcomes, insufficient evidence for 19 outcomes and inconclusive evidence for three outcomes. Interestingly, evidence of harm was also reported for one outcome (**Figure 3.5**).

Figure 3.5: Conclusion in SRs: Effectiveness of interventions for different outcomes



Note: Numbers in the figure indicate outcomes.
Bar chart above gives a break up of 37 outcomes where evidence of effectiveness was reported

Table 3.6 cross tabulates the evidence for each intervention with respect to different outcomes. As shown in **tables 3.6 and 3.7**, positive evidence of effectiveness is reported mostly for health and knowledge outcomes followed by improved capacity and behaviour. Interestingly, evidence of harm was also reported for health outcome as well. Most SRs report insufficient evidence to conclude on effectiveness, even where outcomes of an intervention are discussed. Among 13 reported outcomes with positive evidence of effectiveness, eight SRs provided a narrative synthesis and conclusion. In the remaining outcomes, three reviews undertook a meta- analysis and two did a numerical analysis.

Not many SRs reported on the effectiveness of DM interventions in relation to outcomes. SRs, which reported on effectiveness, covered the following five interventions.

- Medical interventions and rehabilitation, including psychological and psychosocial interventions [Fu et al., 2015; Griffiths & Ford, 2013; Khan et al., 2015; Lipinski et al., 2016; Lopes et al., 2014; Newman et al., 2014]

[5] 2 SRs were empty reviews.

- Capacity, education and training [Codreanu et al., 2014; Hsu et al., 2004; Johnson et al., 2014]
- Cash based interventions [Doocy & Tappis, 2016]
- Mechanisms and models of coordination [Akl et al., 2015]
- Communication and information [Bradley et al., 2014; Hopwood & Schutte, 2016]

These are discussed below and summarized in **Table 3.7**, which gives a summary of findings (SoF) for those SRs which provided conclusive evidence of effectiveness (both positive and negative) of an intervention. It provides a detailed description of intervention, outcome studied, country covered, number of LMIC studies on natural hazards, hazard type and type of synthesis. A detailed description of all the interventions irrespective of the kind of evidence reported (positive, negative, insufficient or otherwise) has been provided in **Appendix 3.1**.

POSITIVE EFFECT OF INTERVENTIONS

MEDICAL INTERVENTIONS AND REHABILITATION

Seven SRs reported evidence of positive effect of medical intervention and rehabilitation for disaster management. Most of these were in the nature of psychological and psychosocial interventions.

Psychological aid, such as Cognitive Behavioural Therapy (CBT), CBT with grief interventions, eclectic with and without CBT components, Eye Movement Desensitization and Reprocessing (EMDR), exposure, relaxation, psychological first aid, and psychological debriefing/crisis intervention and spiritual-hypnosis assisted treatment were reported to have positive health outcomes in the form of psychological wellbeing (Lopes et al., 2014; Newman et al., 2014). Lopes et al., (2014) found positive effectiveness of CBT for earthquake victims. Newman et al. (2014) found psychological interventions to be efficacious in reducing PTSD symptoms amongst children and adolescent survivors of disasters. The SR synthesised findings from 24 studies, but did not report separately for natural disasters and man-made disasters, or high income and low/middle income countries. Meta-analytic results suggest that treatment group outcomes are better than control and waitlist group outcomes on PTSD measures, showing a medium effect size (Cohen's d=.74, SD=.59, 80 % CI=−.02 to 1.49). The weighted mean effect size for the reduction in PTSD symptoms as a result of psychological intervention (pre- vs. post-treatment) was large (d=1.13, SD=.69, 80 % CI=.25 to 2.02), yielding 74% relative improvement (Newman et al., 2014).

Psychological care programmes, mental health programmes, social activity programmes, institution based and individualised rehabilitation programmes were reported to have led to improved health outcomes (functional restoration, improved symptoms or impairments, participation etc.), health care processes and safety in cases of natural disasters in LMICs (Khan et al., 2015). The SR reviewed use of these psychological rehabilitation programmes in the context of earthquakes in China and tsunami in India and Sri Lanka. Post-disaster mental health and psychological interventions designed specifically for school based youth e.g. psycho education, cognitive behaviour techniques, reconstruction of trauma experiences and stress management skills resulted in improved mental and psychological health (Fu et al., 2015). Fu et al., (2015) carried out a meta-analysis of PTSD measures that targeted children and adolescents in disaster settings. The SR included four studies which evaluated

effectiveness of interventions made after Indian Ocean tsunami in Sri Lanka, Sichuan earthquake in China, Spitak earthquake in Armenia, and Marmara earthquake in Turkey. Three of these studies found significant reduction in PTSD as a result of measures such as psychosocial interventions, psychotherapy sessions and ERASE stress programme (including homework review, warm up, psycho educational presentations, coping skills training, and experimental group activity). The impact of intervention in post-disaster setting was found to be statistically significant (-0.308, 95% CI= -0.54 — -0.07, z = -2.58, ρ= 0.010) (Fu et al., 2015). One SR assessed the effectiveness of psychosocial interventions for prevention or reduction in post-traumatic stress disorder (PTSD) symptoms and/or enhancement of psychological wellbeing implemented after the 2004 Tsunami in Indian Ocean. It found interventions such as psycho social care, mixed psycho educational, CBT, narrative exposure therapy, meditation relaxation therapy, mixed stress debriefing etc. had positive effects on reduction in PTSD symptoms and led to improvement in psychological wellbeing (Lipinski et al., 2016). The review found that 8 out of 10 studies reported positive effects of these interventions post tsunami in India, Sri Lanka and Thailand. The studies were also found to be culturally sensitive to the local setting.

In a review of evidence regarding the effectiveness of anti-retroviral therapy (ART) care in disaster settings, overall ART outcomes were found to be satisfactory on the parameters of mortality, follow up, and patient retention for disasters in general – both natural as well as manmade (Griffiths & Ford, 2013). However, patient retention was clearly found to be high in cases of ART care being provided after flooding crisis in Thailand and earthquake in Haiti.

CAPACITY, EDUCATION AND TRAINING

Isolated school based disaster education of teenagers through disaster risk reduction educational programme and hazard education programmes was found to enhance theoretical disaster knowledge, possibly extending to practical skills. There was evidence of enhancement and retention of disaster related knowledge and knowledge of skills (Codreanu et al., 2014). The SR, in its synthesis, did not make a very clear distinction between natural and man-made disasters or HICs and LMICs. However, it reported that schools were the best place for earthquake educational programmes resulting in increased hazard awareness, risk perception, knowledge, and mitigation/response skills. The SR did not find school based education very effective in inculcating behavioural changes.

Effectiveness of disaster education programmes for children was reported in another SR, which found evidence of a positive effect in relation to knowledge outcomes for participating children. Other positive outcomes such as household preparedness were also associated with children's participation in disaster education programmes (Johnson et al., 2014).

Capacity building interventions such as disaster drills for hospital staff to respond to a mass casualty incident were found to be effective in making hospital staff familiar with disaster procedures and response. For example, with respect to incident command, communications, triage, patient flow, materials and resources, and allowing them to use these in a disaster setting (Hsu et al., 2004).

CASH BASED INTERVENTIONS

Cash based interventions such as unconditional cash transfer for assistance, conditional cash transfer and voucher programmes were studied for disaster relief and recovery in low and middle income

countries (Doocy & Tappis, 2016). While the SR focussed on LMICs, it studied effects of cash based interventions in natural and man-made disaster settings together. It synthesised findings based on the nature of intervention – cash transfers or vouchers. In general, both cash based and in kind assistance were found to be effective in increasing and maintaining household food security among drought-affected populations (Doocy & Tappis, 2016). Evidence of positive impact on household economy was not as forthcoming as in the case of food security.

MECHANISMS AND MODELS OF COORDINATION

One SR provided evidence of effectiveness of coordination between organizations, agencies and bodies providing or financing health services in humanitarian crises (including natural disasters) on health outcomes for affected population (Akl et al., 2015). Information coordination and management coordination were found to have a positive impact on health system inputs in the form of improved drug availability and higher level of health services. It was observed that use of information and communication technologies in disaster response could be linked to an increase in the number of support functions and transactions for health and medical care in post-earthquake setting in Turkey. Management and directive coordination was reported to be effective for health system inputs in terms of increased drug availability and medical human resources post cyclone in Bangladesh.

COMMUNICATION AND INFORMATION

The effectiveness of different forms of disaster risk communication, for example, mass media campaign (television, radio, Internet), helplines, face to face communication etc. varies depending on the context. Risk communication interventions (including games, interactive discussion groups or teaching) were found to be especially effective in enhancing preparedness for natural disasters, either through increasing knowledge or improving preparedness behaviour (Bradley et al., 2014).

Limited evidence was also reported about effectiveness of risk communication in the response and recovery phases of disasters to improve knowledge and behaviour of disaster affected population. As response measures, while evacuation warnings were found to be effective in disaster settings in most countries, low voluntary compliance was reported in India (cyclone) and Mauritius (tsunami).

NEGATIVE EFFECT OF INTERVENTIONS

COMMUNICATION AND INFORMATION

One SR reported negative outcomes for communication intervention (Hopwood & Schutte, 2016). In the SR, exposure to print and video media of disasters resulted in negative psychological outcomes for the disaster affected population, especially in terms of anxiety reactions. The meta-analysis carried out by Hopwood and Schutte (2016) found that across studies on different kinds of natural disaster incidents, violence or terrorism incidents, media exposure to disasters and violence was found to have played a causal role in negative psychological outcomes, at least in the short term. Media exposure to disaster or large-scale violence had significant effect on negative psychological outcomes and the overall median effect size for negative psychological interventions was found to be large, g = -1.61 (SE= 0.27, 95% CI= 1.07¬—2.14, ρ< 0.001) (Hopwood & Schutte, 2016).

INSUFFICIENT OR INCONCLUSIVE EVIDENCE

SRs could not report on effectiveness of the following interventions due to insufficient and inconclusive evidence emerging from the studies included in the SRs.

- Adaptation measure
- Behavioural theories and models
- Community based management
- Crisis management
- Emergency Management and Infrastructure
- Health systems approach
- Healthcare
- Insurance
- International Humanitarian Assistance
- Preparedness tools and guidelines
- Relocation
- Reporting and monitoring
- Strategies to manage and allocate scarce resources

Positive evidence of effectiveness was found for medical interventions in seven reviews; for capacity, education and training in three reviews; for cash based interventions, communication and information, and mechanisms and models of coordination in one review each. Evidence of harm was reported for communication and information by one review. No difference as a result of capacity, education and training interventions could be established by one review.

Table 3.6: Evidence of effectiveness of DM interventions and corresponding outcomes (as reported in SRs)

Intervention	Positive evidence of effect	No Evidence of difference	Evidence of harm	Inconclusive evidence	Insufficient evidence
Adaptation measure				Health[5]	
Behavioural theories and models					Reduced risk & vulnerability[14]
Capacity, education and training	Knowledge[10, 23] Improved capacity[20]	Behaviour[10]			Improved capacity[20, 21, 47] Behaviour[23]
Cash based interventions	Sector specific – food security [37]			Health[31], socio-economic[31]	Improved capacity [37] Health[31]
Communication and information	Knowledge[6] Behaviour[6]		Health[19]		
Community based management					Health[41]

Intervention	Positive evidence of effect	No Evidence of difference	Evidence of harm	Inconclusive evidence	Insufficient evidence
Crisis management					
Emergency Management and Infrastructure					Efficient emergency services[22]
Health systems approach					Health[3] socio-economic[3]
Healthcare					Health[42]
Insurance					Socio economic[43]
International Humanitarian Assistance					
Mechanisms and models of coordination	Health[35]				
Medical interventions and Rehabilitation	Health[16, 17, 24, 26, 27, 29]				Health[4, 13, 15]
Preparedness tools and guidelines					Improved disaster management infrastructure[28]
Relocation					Health[40]
Reporting and monitoring					
Strategies to manage and allocate scarce resources					Health[39]

Note: The above table presents information on outcomes

Table 3.7: Summary of Findings (SoF) for different categories of disaster management interventions*

Medical interventions and Rehabilitation

SR_Citation	Intervention details	Outcome category	Outcome details	Effect	Country context	Number of LMIC studies on natural hazards	Hazard context	Type of Synthesis	# Studies	C 8**	C 9**	TS***
Fu et al. (2015)[16]	School based post disaster mental health and psychological interventions on youth e.g. psychoeducation , cognitive behaviour techniques, reconstruction of trauma experiences and stress management skills	Health outcomes	Improved mental and psychological health	Positive	No geographical focus	4 [Armenia (earthquake) (1); China (earthquake) (1); Turkey (earthquake) (1); Sri Lanka (tsunami) (1)]	All (including man-made)	Meta-analysis	11	NA	Y	1
Griffiths & Ford (2013)[17]	Antiretroviral care to displaced populations in humanitarian settings	Health outcomes	mortality, follow up, patient retention	Positive	No geographical focus	3 Thailand (Flooding) (2); Haiti (Earthquake) (1)	All (including man-made)	Numerical narrative	14	Y	Y	2

SR_Citation	Intervention details	Outcome category	Outcome details	Effect	Country context	Number of LMIC studies on natural hazards	Hazard context	Type of Synthesis	# Studies	C 8**	C 9**	TS***
Khan et al. (2015)[24]	Psychological care program, Mental health program; social activity program; rehabilitation programmes	Health outcomes	Functional restoration, improved symptoms/ impairments, participation), health care processes, safety.	Positive	LMIC	10 [China (Earthquake) (8); India (Tsunami)(1); Sri Lanka (Tsunami) (1)]	All natural hazards	narrative	10	Y	Y	2
Lipinski et al. (2016)[26]	Psychosocial interventions (For example, psycho social care; mixed psycho educational, CBT, ART; Narrative exposure therapy and meditation relaxation therapy; mixed stress debriefing etc.)	Health outcomes	Reduction in PTSD symptoms; Improvement in psychological wellbeing	Positive	LMIC	10 [India (4), Sri Lanka(3), Thailand (3)]	Tsunami	narrative	10	Y	Y	2

SR_Citation	Intervention details	Outcome category	Outcome details	Effect	Country context	Number of LMIC studies on natural hazards	Hazard context	Type of Synthesis	# Studies	C 8**	C 9**	TS***
Lopes et al. (2014)[27]	Psychological aid	Health outcomes	Psychological well being	Positive	No geographical focus	Not clear	All natural hazards	narrative	11	Y	Y	2
Newman et al. (2014)[29]	Psychological aid - Cognitive Behavioral Therapy (CBT), CBT with Grief Interventions, Eclectic with and without CBT components, Eye Movement Desensitization and Reprocessing (EMDR), Exposure, Relaxation, Psychological First Aid, and Psychological Debriefing/Crisis Intervention and Spiritual-Hypnosis Assisted Treatment	Health outcomes	Psychological well being	Positive	No geographical focus	Not clear	All (including man-made)	Meta-analysis	24	NA	Y	1

Capacity, education and training

SR_Citation	Intervention details	Outcome category	Outcome details	Effect	Country context	Number of LMIC studies on natural hazards	Hazard context	Type of Synthesis	# Studies	C 8**	C 9**	TS***
Codreanu et al. (2014)[10]	Disaster education intervention. e.g., Disaster risk reduction educational programme, hazard education programmes	Knowledge outcomes	Enhancement and retention of disaster related knowledge and knowledge of skills, DDR, improvement of survival, or decrease in vulnerability. (Secondary outcome)	Positive	No geographical focus	6 [Turkey (Earthquake) (1); Tajikistan (Earthquake) (1); Nepal (Earthquake) (1); Iran (Flood) (1); India (All) (1); South Africa (All) (1)]	All (including man-made)	Narrative	14	Yes	Yes	2
Hsu et al. (2004)[20]	Disaster drills, technology-based interventions and tabletop exercises in training hospital staff to respond to an MCI	Improved capacity to manage disaster risk & post disaster impact	Hospital staff trained to respond to a Mass Casualty Incident	Positive	No geographical focus	Not clear	All (including man-made)	narrative	21	NA	Y	1
Johnson et al. (2014) [23]	Disaster education programmes for children.	Knowledge outcomes	Knowledge of hazard risks, Knowledge of protective actions during	Positive	No geographical focus	Not clear	Not specified	Narrative	35	NA	Y	1

SR_Citation	Intervention details	Outcome category	Outcome details	Effect	Country context	Number of LMIC studies on natural hazards	Hazard context	Type of Synthesis	# Studies	C 8**	C 9**	TS***
			an emergency, Knowledge of mitigation actions, knowledge of recovery actions; Home hazards adjustments, including household disaster preparedness kits and plans									

Cash based interventions

SR_Citation	Intervention details	Outcome category	Outcome details	Effect	Country context	Number of LMIC studies on natural hazards	Hazard context	Type of Synthesis	# Studies	C 8**	C 9**	TS***
Doocy & Tappis (2016)[37]	Unconditional Cash Transfers; Conditional Cash Transfers; Vouchers	Sector specific outcomes	Food security, nutrition status, availability of shelter, access to clean water, school	Positive	LMIC	43 [Bangladesh (1); Belize (1); Haiti (4); Indonesia (10); Mozambique (1); Philippines	All (including man-made)	narrative	113	Y	Y	2

SR_Citation	Intervention details	Outcome category	Outcome details	Effect	Country context	Number of LMIC studies on natural hazards	Hazard context	Type of Synthesis	# Studies	C 8**	C 9**	TS***
			enrolment, etc. Cross cutting coping mechanism			(1); Somalia (3); Niger (1); Ethiopia (3); Pakistan (4); Zimbabwe (1); Swaziland(1); Zambia (1); Kenya (3), Sri Lanka (2); Sudan (1); Uganda (1); Vietnam (3); Zambia (1)]						

Mechanisms and models of coordination

SR_Citation	Intervention details	Outcome category	Outcome details	Effect	Country context	Number of LMIC studies on natural hazards	Hazard context	Type of Synthesis	# Studies	C 8**	C 9**	TS***
Akl et al. (2015)[35]	Mechanisms and models of coordination between organizations, agencies and bodies providing or financing health	Health outcomes	Health outcomes of the affected population; Health outcomes of the host community;	Positive	No geographical focus	3 [Turkey (Earthquake) (1)Mozambique (Flood) (1); Bangladesh (Cyclone) (1)]	All (including man-made)	Numerical narrative	4	Y	Y	2

SR_Citation	Intervention details	Outcome category	Outcome details	Effect	Country context	Number of LMIC studies on natural hazards	Hazard context	Type of Synthesis	# Studies	C 8**	C 9**	TS***
	services. These could consist of one or more of the four categories of coordination: information coordination, coordination through common representation, framework coordination and management/directive coordination.		Access of the affected population to health services; Access of the host community to health services; Impact on health systems input; Health systems inputs									

Communication and information

SR_Citation	Intervention details	Outcome category	Outcome details	Effect	Country context	Number of LMIC studies on natural hazards	Hazard context	Type of Synthesis	# Studies	C 8**	C 9**	TS***
Bradley et al. (2014)[6]	Risk Communication – face to face, television, radio, Internet or telephone communication, or any other method of	Behaviour change outcomes Knowledge outcomes	Health-related behaviour (self-reported or observed) relating to the disaster/possible disaster.	Positive	No geographical focus	5 [Iran (Flood)(1); India (Cyclone (1); Mauritius (Tsunami) (1); Haiti (storm) (1); St. Vincent	All (including man-made)	Narrative	27	NA	Y	1

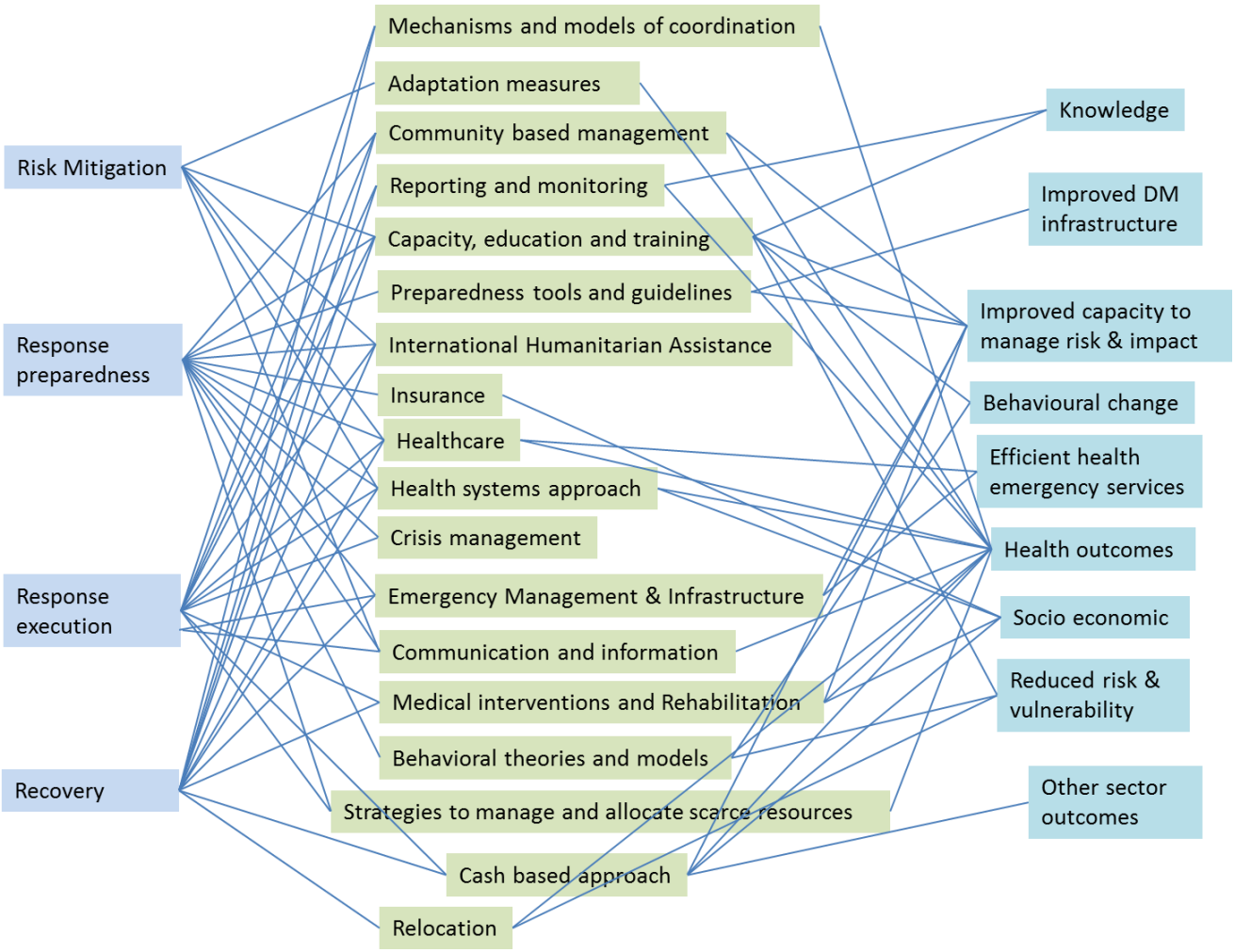
SR_Citation	Intervention details	Outcome category	Outcome details	Effect	Country context	Number of LMIC studies on natural hazards	Hazard context	Type of Synthesis	# Studies	C 8**	C 9**	TS***
	risk communication aimed at informing the public about a potential disaster situation		Incidence of health-related events related to the disaster/possible disaster.			and the Grenadines (All) (1)]						
Hopwood & Schutte (2016)[19]	Media exposure to disasters	Health outcomes	Psychological health	Negative	No geographical focus	Not clear	All (including man made)	Meta-analysis	18	NA	Y	1

*Findings from SRs which reported conclusive evidence on effectiveness of interventions

**C 8 and C 9 are defined as per AMSTAR Online Checklist for Quality Appraisal. C 8: Was the scientific quality of the included studies used appropriately in formulating conclusions? ; C 9: Was the method used to combine the findings of studies appropriate?

***TS: Total Score as per AMSTAR Quality Checklist

Figure 3.4: Disaster Management interventions and outcomes across 4Rs



FACTORS INFLUENCING SUCCESS/FAILURE OF AN INTERVENTION

The reviews included in the evidence summary had various objectives. However, only eight of them included factors influencing the performance of an intervention within their objectives. Reviews with other objectives also discussed some of the barriers, facilitators and challenges in the course of their discussion. The main factors that appear to contribute to success or lack of effectiveness of a disaster management intervention are discussed below. These are categorised into (i) Facilitators, and (ii) Barriers and challenges.

FACILITATORS

Community engagement: Participation and ownership from communities is integral to the success of DM interventions in a natural hazards setting. Communities are directly, and often severely, affected by the impacts of natural disasters. This makes it imperative for communities to be involved in decision making and implementation of interventions geared towards mitigating risks of a disaster, planning or execution of a response and recovery. Petz (2015) discusses how the more communities are consulted and involved in the process, the higher the acceptability of interventions. The review notes how communities being together are an important factor for successful relocations 'in both socio-economic and cultural terms' (Petz, 2015).

Coordination and collaboration: Strong collaboration between different actors, such as non-governmental organizations and service providers, resulted in improved access to medical interventions, such as ART, as reported in Griffiths & Ford (2013). Similarly, collaboration with and involvement of parents in medical interventions for children played an influencing role (Newman et al., 2014). Literature on capacity building also lays emphasis on coordination and relationships between different actors (Scott et al., 2015).

Communication and information: One of the most important factors responsible for the success of interventions was found to be effective communication and information flows. Timely information sharing and exchange of vital information about a disaster as well as information for taking action is important for the success of emergency infrastructure interventions (WHO, 2013), and capacity building (Scott et al., 2015).

Planning and decision making: Griffiths & Ford (2013) report on the role of contingency planning in improving adherence to medical interventions and treatments. Contingency planning may include predicting busy periods or disaster prone seasons and ensuring the availability of contingencies accordingly. Similarly, in case of planning for relocation, a pre-arranged transfer agreement with shelter sites proved to be facilitating the search of shelter sites at the time of a disaster (Bagaria et al., 2009).

Scale of planning has also been discussed as a determining factor in success of a project or approach. Planning on a smaller scale, that is, at the level of communities or municipalities, has a better chance of succeeding and meeting the objectives of an intervention (Petz, 2015). Planning timeframes are also central to effective planning during a disaster, especially for approaches to relocation of disaster affected and vulnerable population (ibid), and for designing capacity building programmes (Scott et al., 2015).

In the case of emergency operation centres, authoritative decision-making and leadership were observed as factors in successful response (WHO, 2013).

Resource availability and technical capacity: The availability of financial resources and technical capacity with the implementing agencies and intended beneficiaries is crucial for the effective implementation of an intervention (Doocy & Tappis, 2016). Technical capacity and level of training of healthcare providers was also discussed in the context of medical interventions (Newman et al., 2014).

Use of new technologies: Use of new technologies such as information and communication technologies can contribute to the success of a DM intervention. It was noted that mobile cash transfers could potentially decrease the time taken and increase the efficiency of programme monitoring (Doocy & Tappis, 2016).

Country/ community ownership: Even when supported by international organisations, capacity building programmes were observed to be most effective when they were country led, resulting in greater ownership and commitment from country and local actors (Scott et al., 2015). In relocation interventions, it was reported that results are more acceptable to the communities where they have been consulted and involved in the process (Petz, 2015).

Population characteristics: Sometimes, the characteristics of a population determine the extent of effectiveness of an intervention. In disaster management settings, prior experience of a community with respect to disasters and managing its impacts is important (Petz, 2015). Similarly, the skills and attitudes of communities could play a role. For example, resilience of disaster affected population may influence how cash based interventions are used and perform (Doocy & Tappis, 2016).

BARRIERS AND CHALLENGES

Ineffective communication: Ineffective communication was reported to be a serious challenge in evacuating and sheltering of hospitals in emergencies. Challenges were primarily in the form of congestion of telephone circuits, failure of emergency equipment, and problems in establishing communication with fire and police departments (Bagaria et al., 2009).

Lack of coordination: Lack of sufficient coordination amongst different agencies and actors were noted as barriers in several instances, including capacity building interventions (Scott, 2015), cash based interventions (Doocy & Tappis, 2016), and emergency operations centres (WHO, 2013). The fragmentation of health services systems due to lack of cooperation among health, fire and police departments in most regions of China posed a challenge to timely medical care (Zhong et al., 2014).

Logistics, equipment and infrastructure: Bagaria et al. reported that logistical challenges were common in transferring patients at the time of hospital evacuation during disasters. Poor access to stairway, elevators, and failure in lighting etc. were common barriers (Bagaria et al., 2009). Continuity of drug supply and equipment, such as portable diagnostics, hindered discharge of medical care and therapy in disaster settings (Griffiths & Ford, 2013; Zhong et al., 2014).

Insufficient organisational capacity: Lack of qualified trained staff and limited financial resources lead to poor organizational capacity and consequently, affect an intervention adversely (Doocy et al., 2016). WHO (2013) noted lack of leadership and decision-making as major challenges to effective

emergency operation centres. Complicated and unclear decision making hindered efficient transfer of patients in hospital evacuations too (Bagaria et al., 2009).

Delays and time pressures: Timeliness is imperative for success of an intervention. Delays in implementation, especially when it relates to access to something or processing of payments can result in lack of trust and undue hardships (Doocy & Tappis, 2016). Time pressure can also result in hurried planning and implementation. As reported by Scott et al. (2016), mismatch between the short timeframes of donor funding and project management cycles can result in 'squeezing out of local partners'.

Lack of plans and legislation: Lack of specific disaster plans and specific emergency legislation that can be implemented locally were reported as legal obstacles for disaster health management (Zhong et al., 2014).

Lack of understanding of local context: Given that many disaster management interventions flow out of multilateral or bilateral aid, ensuring due consideration to local context is important. However, it is not often the case. Strong understanding and sensitivity to country context is not embedded into most programmes. This results in compromised results of an intervention, where the needs of the vulnerable or marginalised people go unattended (Scott et al., 2015).

ACTORS INVOLVED IN DISASTER MANAGEMENT

Different actors play different roles across a disaster management cycle. They may play the role of decision makers, implementers, supporters, catalysts, enablers, or even barriers. The roles often interact, and may not be clearly distinguished between those of actors and potential stakeholders (Brink et al., 2016).

None of the reviews included in the evidence summary aimed at mapping the existence of different actors and their role in disaster management. A few reviews did discuss the role of the key stakeholders in the context of the review. While we are cognizant of the fact that a multitude of actors that perform various, often interconnected, roles during the four stages of disaster management, we list below the actors that have been discussed in 17 systematic reviews included in this evidence summary.

Government and policy makers: Drivers for enhancing capacity for disaster risk management include state actors who coordinate activities at national, state and local levels, and other national governmental bodies such as disaster preparedness agencies, or public health departments. Most capacity building activities operate via agencies or institutions established for disaster management (Scott et al., 2015).

Governments are more actively and directly involved in some disaster management interventions, such as disaster shelters. Veenema et al. (2015) reported on multiple shelters being run by governments, especially local government, and humanitarian response non-government organisations. Government structures can assist disaster-affected populations in sheltering or making use of a disaster intervention.

Governments also play a major role in issuing guidelines, advisories, communication documents for awareness and preparedness (Costa et al., 2015; Veenema et al., 2015; Petz, 2015).

Lastly, one of the key functions of governments is with respect to decision-making. Local and state governmental emergency management decisions influence the preparedness, uptake and success of an intervention (for example in case of relocation and emergency shelters) (Petz, 2015; Veenema et al., 2015). In a review of evidence on strategies to optimize the management and allocation of scarce resources in mass casualty incidents, four categories of functions were listed, under which policy makers may take actions. These are management and reduction of less urgent demand for health care services; maximising use of existing resources; augmenting resources; and implementing strategies consistent with crisis standards of care (Timbie et al., 2013).

Non-government organisations and aid agencies: Most disaster management interventions, whether they are for response preparedness, execution or recovery, are not designed and implemented by any one group of stakeholder. These comprise efforts from various agencies and citizens, including non-government organizations (Soltani, 2014). Akl et al. (2015) note that the main actors involved in helping in a humanitarian crisis setting and experimenting coordination include UN agencies, local NGOs, international NGOs and government agencies.

Often, it is NGOs who lead an intervention during a disaster. Participation from citizens and NGOs was crucial in ecosystem based adaptation measures (Brink et al., 2016). The participation and

engagement with citizens and NGOs was both top down as well as bottom up. NGOs are integral to implementation of grass root measures. A review of crop based insurance measures observed that around half of the studied projects liaised with a local NGO for implementation (Shawn, 2012). Scott et al. (2015) identify the role of multilateral and bilateral donors (including UN bodies and INGOs), and NGOs nationally or locally in a country in capacity building for disaster risk mitigation.

Technical and sector professionals: Technical experts are needed for certain specific activities in a disaster management approach. Experts are needed for measuring institutional emergency preparedness (Heidaranlu et al., 2015). Rescue experts, environmental scientists, geologists, engineers, construction contractors are needed for designing shelter plans and sites (Soltani et al., 2014). Hopwood and Schutte (2016) discuss the effect of media exposure to disasters on disaster affected and vulnerable population and find negative effect. In this regard, it is important that the role of media professionals is recognized in framing the narrative and communicating the information.

Reviews on school based disaster inventions clearly recognize the role of teachers and educational institutions in implementing a DM intervention and its success (Fu et al., 2015; Johnson et al., 2014).

Depending on the DM intervention, the sector experts and personnel become central to the act of disaster management. For example, in case of medical interventions, health personnel and institutions are central to disaster management actions (Ejeta et al., 2015; Hsu et al., 2004; Khan et al., 2015; Zhong et al., 2014).

3.4 GAPS IN EVIDENCE

Literature discusses a number of approaches to address disaster management across different phases of disaster management or the 4Rs. However, not all DM approaches are reported in systematic reviews. As detailed in the section on overview of evidence, SRs that meet the inclusion criteria review 18 interventions or DM approaches (see table 3.4 for all the DM approaches covered in the SRs included). Many important disaster management approaches, such as engineering based approaches and environmental approaches to risk mitigation and management, are not adequately covered in the synthesis due to lack of good quality systematic reviews.

Empirical evidence on medical interventions, including medical rehabilitation, after natural disasters is increasing, and various systematic reviews evaluate effectiveness of rehabilitation in survivors; however, most reviews provide a narrative synthesis and do not give conclusive evidence of effectiveness (or ineffectiveness) of an intervention. The number of meta-analysis or quantitative reviews is very low. Even where effectiveness is evaluated or discussed, it is concluded in most SRs that the evidence is either insufficient or inconclusive to prove effectiveness. As per the classification in Fox et al. (2012), findings from the SRs fall under the category of "*evidence informed but without proof of effectiveness*".

There are significant interventions, however, that go beyond the medical and health domain. There is a scarcity of studies which systematically analyse various non-medical interventions in natural disaster settings. The benefit and harm associated with these interventions need to be established comprehensively to guide disaster management teams and policymakers. Although evidence for

effectiveness of disaster management approaches in natural disaster victims is limited, the gap in current research should not imply ineffectiveness of interventions. The challenge is to conduct rigorous trials in complex disaster settings to assess outcomes for interventions. More methodologically robust studies are needed to build evidence for disaster management interventions, feasibility and cost-effectiveness, and outcome measurement in such settings.

As mentioned in the evidence summary, very few systematic reviews had a clear focus on LMICs. These included countries from across the world. None of the reviews focused on the South Asian region. Even though South Asian countries were included in SRs, these primarily were Sri Lanka, India and Nepal. The reviews that had no geographical focus, and included HICs and LMICs, did not make a distinction or comparison between the two categories of countries.

The emphasis of reviews, and the studies included therein, is clearly biased towards studying medical interventions. In terms of phase of disaster management, risk mitigation is an under researched area when it comes to DM interventions.

The context of LMICs was not given enough consideration while reviewing different disaster management interventions and their outcomes. None of the reviews compared the effectiveness of interventions in HICs and LMICs or same group of countries with different contextual factors. This made contextualisation of findings of the evidence summary difficult.

There is clearly a need for further good quality empirical studies that assess the effectiveness of DM interventions, especially those that go beyond medical interventions. There is also a need for studies that focus on South Asia as a region, or South Asian countries.

4. CONTEXTUALISATION FOR SOUTH ASIA

Natural disasters impose a large socio-economic burden with significant cost in terms of health care; infrastructure; and the environment (Khan et al., 2015). With increasing world population, occurrence of natural disaster has increased annually by 5% along with 4% increase in the number of people affected by these disasters. Intensity of damage caused by natural disasters increases with population density of area region, for instance, in South Asia, damage is comparatively high in terms of deaths and affected population due to higher population density (Lopes et al., 2014). New residents and urban poor living in peri-urban areas and informal settlements concentrated in high-risk zones are particularly vulnerable to natural hazards due to lack of adequate infrastructure, insufficient enforcement of building codes in relation to earthquake, a near absence of financial and insurance mechanisms that help transfer risk, and limited access to basic and emergency services. All these factors are creating obstacles and contributing to the challenges on DRR and building resilience.

As mentioned in the previous sections, there have not been many systematic reviews with a clear focus on LMICs or even the South Asian region. Most of the reviews had mixed geographical focus, including those from HIC, LMIC including South Asia. The objective of this Evidence Summary has been to draw evidence with respect to South Asia, especially Bangladesh. However, following mixed or no geographical focus of these systematic reviews, it is difficult to contextualise. Thus, few of the interventions revealed in the SRs which have been a success in the region or in a country similar to South Asia in terms of population, geographical location, culture, livelihood pattern, food habits and demographic conditions (such as Sri Lanka, Thailand, China etc.) have been identified and considered

for contextualisation. An attempt has been made to identify and evaluate the contextual factors for South Asia region, which are described in the reviews presented below.

There are several contextual factors that could have an impact on effectiveness of a disaster management intervention in a specific country or regional setting. There are certain general social, political, and economic contextual factors which are indispensable for the effectiveness of disaster management approaches. These include (i) nature and scale of disaster, including the stage of disaster, (ii) frequency of disasters in the region or country, (iii) impact of a disaster across areas and population, (iv) characteristics of affected and vulnerable population including their levels of literacy, income, prior experience of disaster, resilience, cultural practices, adaptability etc. (v) capacity of institutions and communities to use an intervention (including skills, infrastructure, resources (human and financial), social and political factors etc.).

Maximum interventions have their genesis in the developed countries, with its proven efficacy, to a population. However, efficacy of these interventions in developing countries depends on whether interventions are adapted according to local, cultural and religious diversity of the population. The intervention model should incorporate, as far as possible, indigenous concepts, practices and wisdom that have been adopted for decades by the local tribes and communities in their approach in response to any disaster. It is essential that these populations do not view the intervention as an imported approach, but as a proven technique that requires cultural adaptations for a better result.

MEDICAL INTERVENTIONS AND REHABILITATION

South Asian countries face various challenges in managing natural disasters due to availability of limited healthcare resources such as infrastructure, health professionals, medical importunes etc. Thus, it becomes crucial to focus on those medical interventions which require fewer resources, and have the potential to improve the diagnosis, management and care of patients injured after natural disasters in a cost efficient manner. It has been highlighted that, for comprehensive management, there is a need to understand geographical location and availability of the local health services, trained rehabilitation professionals and medical workforce. Special needs and management plans for persons with pre-existing disabilities and/or comorbidities are often disregarded, which needs to be emphasized while formulating rehabilitation plans (Khan et al., 2015).

With an increasing frequency of natural disasters, there is a greater focus on the role of rehabilitation in disaster management. However, there are only a few studies which have focused on LMICs, particularly on South Asian countries (Khan et al., 2015; Lipinski et al., 2016). There has been some evidence for the effectiveness of inpatient rehabilitation in reducing disability and improving participation and quality of life and for community-based rehabilitation for participation. Post-traumatic stress disorder (PTSD) is one the most common psychiatric disorders observed among natural disaster survivors. School based or community based psychological rehabilitation intervention in countries like India and Sri Lanka have shown evidence reducing emotional distress among children and women exposed to tsunami and earthquake (Khan et al., 2015; Lipinski et al., 2016). In this intervention, community workers were taught basic mental health interventions by team of psychiatrists, nurses, and social workers. Both cultural and gender aspects have been incorporated in formulating these interventions (Khan et al., 2015; Lipinski et al., 2016). In Sri Lanka, counsellors used

practices like yoga and meditation with the Buddhist communities to reduce the PTSD symptoms in the survivors. Also, female facilitators have been utilized for young female participants (Lipinski et al., 2016).

Some systematic reviews have no geographical context but they did consider mixed countries (both HICs and LMICs) in the scope of the study (Fu et al., 2015; Griffith and Ford, 2013). One such study[6] evaluated rehabilitation programs in Sri Lanka post 2004 Tsunami. Classroom-based programs were conducted by teachers for elementary school students providing them with psycho-education material, and exercises for cognitive-behavioral skills, meditative practices, and bioenergetics. These programs showed significant reduction in trauma related symptoms in the students following the interventions (Fu et al., 2015).

Studies have also emphasized the efficacy of cognitive-behavior therapy, particularly exposure techniques, for the treatment of post-traumatic stress disorder after earthquakes (Lopes et al., 2014). Results of a review mentioned enhanced outcome following parental involvement in the treatment of children suffering from PTSD post disaster (Newman et al., 2014). However, these reviews do not have any geographical focus and do not make any distinction between HIC and LMIC. Thus, it is not possible to disaggregate the findings to country level, therefore limiting the generalizability for South Asian countries. But this factor can be looked upon in further research in the South Asian context.

These psychological rehabilitation interventions will be especially helpful and effective in resource-poor regions which have few trained mental health professionals. Given the availability of limited health infrastructure in South Asian countries, community-based approach can be incorporated as part of a comprehensive disaster health management plan. In order to increase acceptances from the community, there is a need to gear the intervention strategies with incorporating cultural norms and traditional beliefs. In terms of long-term psychological disorders and impaired functioning, women, children and disabled survivors are identified as the most at-risk population post-disaster. Understanding special needs of these vulnerable groups is essential for an intervention to succeed. Therefore, it is important to provide services to children affected with psychological distress post-disaster. And for implementation of interventions for children, schools have proven to be the most appropriate option outside one's home. Also, teachers, if trained as non-professional mental health workers, can also play an important role in the process of alleviating distress from the children. Given the success of this type of intervention in Sri Lanka and also in some parts of India, these community based psychological rehabilitation interventions can be applied in other South Asian countries as well. This also helps in resolving the issue of health infrastructure to some extent as there are already enough schools and teachers in South Asian countries.

Despite the importance of an effective health system response to various disasters, relevant research is still in its infancy, especially in LMICs. Most of the existing research related to health systems' disaster management or the capability to supply medical services during disasters has occurred in HICs. Hence, there is a lack of evidence of effectiveness in LMICs especially in the context of South Asian countries.

[6] Fu et al., 2005

MECHANISMS AND MODELS OF COORDINATION

Coordination forms a crucial aspect for the response strategies for disaster management as it can increases the flow of resources, enhances accountability and increases the effectiveness of a relief effort. While evaluating the systematic reviews, only one systematic review evaluated the effectiveness of coordination between organizations in improving health systems outcomes (Akl et al., 2015). The study finds very low quality evidence suggesting that information coordination between organizations, agencies and bodies may be effective in improving health systems inputs. However, one of the studies which was included in this systematic review found positive impact of coordination efforts on the availability of drugs and manpower and other health response in Bangladesh post 1991 cyclone (Akl et al., 2015). Yet, it will be difficult to contextualize that the coordination between organizations can improve health system outcomes in other South Asian countries.

Presently, coordination among the organizations and agencies providing medical and health assistance is very low in the South Asian countries leading to inefficiencies, inequity and duplication in the services to the targeted population. In Bangladesh, the health sector emergency response preparedness (EPR) coordination mechanism is jointly led by WHO and the Government of Bangladesh (GoB). It is in place at the national level but is very poor at the peripheral level. WHO suggests that health EPR committees need to be developed and activated at the subnational level to improve the coordination mechanism (WHO, 2013).

CASH BASED INTERVENTIONS

Effectiveness of cash based interventions in the event of humanitarian emergencies has been studied by only one SR with geographical focus on LMICs (Doocy & Tappis, 2016). There are different types of cash-based interventions (such as conditional cash transfers, unconditional cash transfers, vouchers etc.) to humanitarian assistance which are collectively referred to as cash transfer programmes. A conditional cash transfer requires recipients to meet certain requirements before the transfer is fulfilled. In contrast, grants paid to beneficiaries without the beneficiary having to do anything specific to receive the benefit are referred to as unconditional cash transfers (or “cash payment without associated activities”). They provide the recipients with additional, rapidly available income to enable them to manage better the negative consequences of disasters, including on health. Vouchers are coupons, tokens or smartcards, which can only be used in particular shops and/or on particular items.

Cash transfer programmes and vouchers improve household food security among conflict-affected populations and maintain household food security within the context of food insecurity crises and drought. Studies found that unconditional cash transfers led to greater improvements in dietary diversity and quality than food transfers. However, food transfers were found to be more successful in increasing per capita caloric intake compared to unconditional cash transfers and vouchers (Doocy & Tappis, 2016).

Usage of local finance institutions, including banks, micro-lenders, and *hawala* were considered preferable to physical cash distribution. They offer dual advantages; first, they allow beneficiaries to withdraw funds multiple times in smaller amounts at one point of time, and second, reduce the requirement for agency staff to travel into the field with large amounts of cash. Use of new

technologies such as electronic transfers or smartcards reduces the time required for cash transfer and increases the efficiency of programme monitoring. There are other factors which form a crucial component for the success of cash transfer programs, such as sufficient organizational capacity, availability of qualified staff and sufficient financial resources. One such factor which facilitates implementation on multiple levels and is not restricted to cash based programs is effective coordination. In many instances, international organizations, often without government participation or plans, provided cash-based assistance for disaster-affected populations for maintenance of achievements beyond the life of a project (Doocy & Tappis, 2016).

Lastly, local finance institutions play an important part for implementing and creating awareness of importance of cash based interventions. These institutions can be utilized wisely and meticulously by South Asian countries for implementing this approach as it does not require additional infrastructure. There is a need to put the emphasis on coordination even though it is not unique to cash based interventions, but challenges may be greater due to the fact that humanitarian coordination mechanisms are structured around sectors of intervention (including health, shelter, and education) and cash can be used for varied purposes.

CAPACITY, EDUCATION AND TRAINING

An effective disaster response can only be achieved through sufficient advance preparation before the occurrence of any disaster (Zhong et al., 2014). **Disaster education** is one of the approaches towards preparedness to reduce the negative consequences of a disaster. This may include education on disaster risk, mitigation and preparedness strategies. According to the Hyogo Framework for Action (2005-2015), the objective of education on disaster is 'to build a culture of safety and resilience at all levels,' in order to reduce the adverse social and economic impacts of hazards (Johnson et al., 2014).

Children form one of the most vulnerable categories of population at risk with respect to their capacity to prepare for, or respond to, the effects of a disaster. To lessen the vulnerability of children, over the last decade, emergency management agencies, schools and non-governmental organizations have increasingly invested in the disaster education program for children. UNISDR also recognized the role of school education and knowledge in the formation of sustainable communities and came up with a slogan ''Disaster risk reduction begins at school" in 2006-2007. The campaign was designed to motivate children towards an enhanced disaster knowledge and disaster resilience behavioural change. Recognizing this position of children in disasters, many countries have acted on it. They have organized awareness programs about children's needs during such situations and some have also introduced disaster education in schools, which includes risk analysis, awareness and reduction, and disaster management (Codreanu et al., 2014).

It has been witnessed that specific interventions, or disaster education for children in general, produce benefits to children as well as the wider community. Interventions resulted in an increase in knowledge base regarding disaster and improved risk perceptions among children. However, best results were obtained by combining theoretical and practical activities in school, family, community, and self-education programs. Therefore, risk awareness needs to be part of early education programs which will lead, in turn, to an individual's growing civic and professional responsibility (Codreanu et al., 2014).

There are other SRs which have contemplated the impact of training and capacity building in the event of a disaster. Johnson et al. (2014) found that children's participation in disaster education programs had positive impact on a household's preparedness for disaster. One of the SRs that reviewed the effectiveness of training of hospital staff in mass-casualty incidents concluded that current evidence of effectiveness of MCI (mass casualty incident) for hospital staff is limited. A number of studies suggest that disaster drills can be effective in training hospital staff. However, it will be difficult to draw lessons from these SRs for South Asian countries as they do not hold any geographical focus. Thus, it is difficult to identify contextual factors on the basis of which of these interventions can be applied in South Asian countries.

Disaster education, either in addition to a stand-alone curriculum or as an extra-curricular program, can be replicated in the South Asian countries as they have an increasing focus on primary education. With the SDGs in focus, developing economies are paying attention and creating holistic awareness in the communities regarding the importance of education for a society as a whole. This also helps in transfer of knowledge from children to parents (Johnson et al., 2014).

COMMUNICATION AND INFORMATION

'Risk communication aims to provide the public with information about the effects of an event, and how actions may affect the outcome of the event' (Bradley et al., 2014). These interventions are used across various phases of a disaster's life cycle. Potential channels of communication include face to face conversations, telephone calls, group meetings, mass media such as television etc. Bradley et al. (2014) found positive effect of risk communication interventions in terms of behaviour change, reduced risk and vulnerability, and knowledge outcomes. One successful example of communication intervention was observed in Iran, in which community participation approach was used for preparedness and mitigation of floods. Village disaster teams were developed to conduct training of local people which includes identifying areas at risk of flooding, developing personalized plans, developing early warning systems and conducting evacuation exercises over a period of three months (Bradley et al., 2014). These type of community based interventions already exist in some South Asian countries (such as India) but there is a need to encourage them further, with enhancement in early warning alerts through several communication channels such as information dissemination from national to local level through several layers of government, translation into local languages at district level, and locally through oral dissemination. Generally, warnings in local languages with use local dialect are not widely disseminated, which can alert communities to take measures which ensure their safety when disaster strikes. Authenticity of these early warnings is also a challenge. Rather than different bodies for different disasters/hazards, the focus should be on one body disseminating all the warnings. Dissemination of information to the local level at the earliest possible period with minimum time delay would strengthen the impact of disaster preparedness programmes.

LESSONS LEARNT FOR BANGLADESH

In the evidence summary we conducted, most of the reviews from which contextualization has been drawn neither had any geographical focus nor make any distinction between HIC and LMIC. Thus, it was not possible to disaggregate all the findings to country level, limiting the generalizability for South Asian countries. As a result, transferability and applicability of an intervention in the context of South

Asia, especially in Bangladesh, is a cause of concern. However, an attempt has been made to draw from interventions which have been carried out in settings similar to South Asia in terms of population, geographical location, infrastructure, resources etc.

Bangladesh, like other South Asian countries, faces the issue of resource constraints which include shortage of funds, trained mental health professionals, among other issues. Given the positive effects of community based approaches, this intervention can be incorporated as part of a comprehensive disaster health management plan. There is a need to gear the intervention strategies by incorporating cultural norms and traditional beliefs which will enhance community participation during disaster management interventions. Bradley et al. (2014) also found a positive effect of risk communication interventions through community participation approach for preparedness and mitigation of floods in Iran. These community based interventions exist but there is a need to further strengthen them, while simultaneously enhancing early warning alerts through several communication channels such as information dissemination from national to local level through several layers of government, translation into local languages at district level and locally through oral dissemination. This information dissemination to the local level at the earliest possible period with minimum time delay would strengthen the impact of disaster preparedness programmes.

Cash based interventions have had positive effects and can be implemented with the help of local finance institutions including banks, micro-lenders, and hawala, as they require no additional infrastructure (Doocy & Tappis, 2016). There is a need to put the emphasis on coordination even though it is not unique to cash based interventions, but challenges may be greater due to the fact that humanitarian coordination mechanisms are structured around sectors of intervention (including health, shelter, and education) and cash can be used for varied purposes. The evidence on the effectiveness of coordination between organizations in improving health systems outcomes is limited (Akl et al., 2015). However, one of the studies which was included in this systematic review found positive impact of coordination efforts on the availability of drugs and manpower and other health response in Bangladesh post 1991 cyclone (Akl et al., 2015). In Bangladesh, the health sector emergency response preparedness (EPR) coordination mechanism is jointly led by WHO and the Government of Bangladesh (GoB). It is in place at the national level but is quite poor at the peripheral level. WHO (2013) suggests that health EPR committees need to be developed and activated at the subnational level to improve the coordination mechanism.

Evidence found that disaster education intervention for children resulted in increase in knowledge base regarding disaster and improved risk perceptions among children as well as for the wider community. In the case of Bangladesh, under CDMP programmes, issues on hazards, vulnerability, DRR measures have already been made part of education system from elementary-secondary to tertiary level of education. In addition, different certificate courses, postgraduate diploma courses, Bachelor of Science (Hons.) and Masters in disaster management have been introduced in different public and private universities (Islam, n.d.). However, the best results were obtained by combining theoretical and practical activities in school, family, community, and self-education programs (Codreanu et al., 2014). Given the context, the evidence reviewed offers some insights but the paucity of rigorous research on effectiveness of disaster management approaches for South Asia (especially for Bangladesh) limits the strength of the conclusions.

5. CONCLUSION

This evidence summary studied and synthesised evidence from 47 systematic reviews. These systematic reviews were selected after an extensive search, two stage screening, and a quality assurance process. A narrative synthesis was done for the SRs dealing with different interventions and corresponding outcomes across the four phases of disaster management.

Most reviews focussed on interventions for response execution while only a few of them focussed on risk reduction. In most of the reviews, the scope was not specific to any one of the natural hazards, rather included a broad category of natural disasters. Similarly, more than half of the reviews did not have any geographical focus and included both LMICs and HICs. Only 10 reviews had a clear focus on LMICs.

Among different categories of disaster management intervention, the majority of reviews focused on medical interventions (mainly on psychological aid), followed by capacity interventions. The outcome which was analysed by most of the reviews (even by non-medical interventions) was health outcomes.

All the reviews reported outcomes of interventions, however evidence on effectiveness (or ineffectiveness) was provided in only some of the cases. Out of 47 included SRs, only 26 SRs aimed to review the effectiveness of a disaster management intervention, including impact of a DM intervention on a particular outcome. Most of these systematic reviews have not conducted quantitative analysis or meta-analysis of studies included in them.

A large number of SRs included in the evidence summary reported that there is insufficient or inconclusive evidence to determine the effectiveness of a disaster management intervention. However, positive evidence of effectiveness was found for 12 interventions in relation to 13 outcomes.

Six SRs reported evidence of positive effect of medical intervention and rehabilitation for disaster management. Most of these were in the nature of psychological and psychosocial interventions. Three SRs found capacity building and education interventions to have positive effect on knowledge and behaviour outcomes. Disaster education programmes for schoolchildren, teenagers and capacity building interventions such as disaster drills for hospital staff were found to be effective in improving knowledge outcomes and have an impact on behavioural outcomes too. One SR reported cash based interventions such as unconditional cash transfer for assistance, conditional cash transfer and voucher programmes to be effective in increasing and maintaining household food security among drought-affected populations. Evidence of effectiveness of coordination between organizations, agencies and bodies providing or financing health services in humanitarian crises (including natural disasters) on health outcomes for affected population was reported in one SR. Effectiveness of different forms of disaster risk communication, for example, mass media campaign (television, radio, Internet), helplines, face to face communication etc. varies depending on the context. Risk communication interventions (including games, interactive discussion groups or teaching) were found to be especially effective in enhancing preparedness for natural disasters, either through increasing knowledge or improving preparedness behaviour.

Several factors have been identified by the SRs which act as facilitators or barriers contributing to the success or failure of a disaster management intervention. Most of the reviews highlighted the importance of coordination and collaboration and community engagement to increase the

acceptability and swift implementation of an intervention in natural hazard setting. There has been growing recognition of the importance of technology such as information and communication for success of disaster management intervention. Major barriers which affect the outcome of disaster management intervention are insufficient organizational capacity, lack of coordination, lack of understanding of local context etc. The role of different actors across disaster management cycles has not been clearly specified by most of the systematic reviews. However, the role of school teachers and disaster education has been found significant in successfully implementing school based disaster management interventions.

Based on the results of included systematic reviews, implications for policy and practice and also the gap in research are highlighted in the next subsection.

5.1 IMPLICATIONS FOR POLICY AND PRACTICE

The systematic reviews included in this evidence summary cover a wide range of interventions for management of natural hazards and their impacts. However, all the SRs vary in their approach, size (number of studies included), scope and method of synthesis. Therefore, it is not possible to ascertain which intervention is most effective in managing disasters.

Of the various interventions covered in the different SRs, positive evidence of effectiveness was found for medical interventions; capacity building and education; communication and information, mechanisms for coordination; and cash based interventions. These SRs represent a diverse set of disasters and country settings. This section discusses some implications for policy and practice that can be drawn from the SRs included in this evidence summary.

Coordination and collaboration: The governments and the donor agencies must foster a strong collaboration between different actors, such as non-governmental organizations and service-providers, resulting in improving access to interventions. The role of coordination and collaboration in making an intervention effective has been highlighted, especially in cases of medical interventions and capacity enhancement programmes. Such collaboration is needed between academics and practitioners or the organisations working in the field. This would be useful in bridging the research and practice gap.

Lead organisations can play a major role by coordinating and establishing effective partnerships with local and international agencies, donors, and academic institutions and conducting monitoring and evaluation. Collaboration and building strong partnerships with the target stakeholders or disaster affected population can improve the uptake and effectiveness of interventions. There is also a case for strengthening the stewardship role of host governments and government departments.

Community engagement: Participation and ownership from communities is integral to the success of DM interventions in a natural hazards setting. Communities need to be involved from the beginning, where they can play a role in decision making and implementation of interventions geared towards mitigating risks of a disaster, planning or execution of a response and recovery. Reviews suggest that there is a higher acceptability of interventions when more communities are consulted and involved in the process. Even when funded by international agencies, programmes were observed to be most effective when they were country led, resulting in greater ownership and commitment from country and local actors.

Socio-economic and cultural context and practices: Evidence suggests that the analysis of socio-cultural factors can be made relevant at policy level to devise necessary and appropriate strategies to counteract exclusion processes in disaster management for inclusive outcomes. It is clear from the reviews that interventions which were sensitive to the socio- cultural context and practices of the target region had a more positive impact and wider acceptance. It was observed that failure to understand and integrate the local context may result in compromised results of an intervention.

Use of new technologies: A more optimal use of new and emerging technologies can assist in better implementation of disaster management programmes. This is especially true for disaster communication and preparedness. Evidence of use of ICT in beneficiary targeted interventions like cash transfers can result in improved efficiency and monitoring. There is a need to address the issue of the gap in technological innovation regarding geospatial infrastructure, enhancing research capacities and technological transfers whilst promoting the sharing of skills, knowledge, ideas and coping mechanisms amongst countries in South Asia region.

Capacity building: There is some evidence that isolated school-based interventions enhance the theoretical disaster knowledge which may also extend to practical skills; however, disaster behavioural change is not forthcoming. Therefore, it is important that theoretical knowledge gets translated into practical knowledge and behavioural change. It seems that the best results are obtained by combining theoretical and practical activities in school, family, community, and self-education programs. There is still a pressing need for a concerted educational drive to achieve disaster preparedness behavioural change, and that school leavers' lack of knowledge, knowledge of skills, and adaptive behavioural change is detrimental to their chances of survival. The disaster education intervention can be supplemented with programmes like mock drills to enhance practical skills. Technical capacity of implementing agencies, trainers, care providers etc. too has been highlighted in several SRs.

There is a need to develop a national research agenda on Disaster Risk Reduction. This consolidated research agenda can serve to advance a more coordinated approach to the research and innovation work, not only within the Platform but across the broader DRR community. It would help inform the science and technology requirements for a range of research, science, technology and innovation partners. Regionally, it will benefit from increased exposure to the research and practice of other nations as well as from the opportunity to engage in new physical, technical, and social research.

Disaster management policies must incorporate evidence based programs to protect the most vulnerable segments of society—the poor, marginalized, women, children, disabled, and elderly. Mechanisms must be designed and adopted for transferring lessons learned for pre- and post-disaster management between communities.

With recent trends showing an increasing frequency and intensity of natural hazards, there is a greater need for augmenting the continued political commitment to keep the momentum going for building resilience. The national, state and local governments need to understand their vulnerability and exposure especially within their development paradigms in order to design and implement effective adaptation and disaster risk reduction strategies. Resilience can only be achieved when learnings of past disasters are analyzed, are used for improving functional capabilities to cope with disasters and a synergy in the approach and strategies for better risk reduction is brought about in the country as a whole.

5.2 IMPLICATIONS FOR DESIGNING FUTURE RESEARCH

The identified evidence for the effectiveness of disaster management approaches from this review is limited and not robust enough to draw generalizable conclusions about the success of the interventions in specific locations. In the studies reviewed, the limited evidence received is skewed towards administering medical interventions pre and post disaster. Meta-analytic results of the existing literature also indicate that disaster interventions for children and adolescents are efficacious. However, more outcomes research on emerging and existing interventions is needed to enhance public health interventions and address issues that cannot yet be determined based on the existing literature. Also, the role and effectiveness of technologies has been discussed and studied by few SRs , which could have an implication for successful implementation of an intervention. Future research would benefit from including evaluations of cost-effectiveness and ease of dissemination.

Research studies are needed in this field to better inform decision-making of different stakeholders working in providing and financing services in humanitarian crisis. The evaluation research would benefit from better collaboration between academic researchers and organizations working in the field. Researchers are also encouraged to develop guidelines for conducting and reporting studies on coordination mechanisms in disaster settings given the complexity of evaluating effectiveness in such fields.

While significant achievements have been made in post-disaster response and reconstruction, there are still formidable challenges to reducing the risk of future disasters. Climate change has far-reaching implications for managing disaster risk in India, as the frequency and intensity of flash floods, landslides, droughts, cyclones, and storm surges are expected to increase in upcoming decades. Climate sensitive disaster management planning can play a tremendous role in terms of reducing increasing disaster risks.

6. LIST OF INCLUDED SYSTEMATIC REVIEWS

Short title	Authors	Title
1. **Babaie et al. (2015)**	Babaie J, Ardalan A, Vatandoost H, Goya MM, and Akbarisari A.	Performance assessment of communicable disease surveillance in disasters: a systematic review.
2. **Bagaria et al. (2009)**	Bagaria J, Heggie C, Abrahams J, and Murray V.	Evacuation and sheltering of hospitals in emergencies: a review of international experience.
3. **Bayntun (2012)**	Bayntun C	A health system approach to all-hazards disaster management: A systematic review
4. **Becker et al. (2016)**	Becker Dawn M, Tafoya Chelsea A, Becker Soren L et al	The use of portable ultrasound devices in low- and middle-income countries: A systematic review of the literature
5. **Boeckmann & Rohn (2014)**	Boeckmann M, and Rohn I	Is planned adaptation to heat reducing heat-related mortality and illness? A systematic review
6. **Bradley et al. (2014)**	Bradley DT, McFarland M, and Clarke M.	The Effectiveness of Disaster Risk Communication: A Systematic Review of Intervention Studies
7. **Brink et al. (2016)**	Brink Ebba, Aalders Theodor, Ádám Dóra, Feller Robert, et al	Cascades of green: A review of ecosystem-based adaptation in urban areas
8. **Challen et al. (2012)**	Challen K, Lee AC, Booth A, Gardois P, Woods HB, and Goodacre SW	Where is the evidence for emergency planning: a scoping review
9. **Chu & Guo (2014)**	Chu TA, and Guo XL. 2014	Remote Sensing Techniques in Monitoring Post-Fire Effects and Patterns of Forest Recovery in Boreal Forest Regions: A Review
10. **Codreanu et al. (2014)**	Codreanu TA, Celenza A, and Jacobs I.	Does disaster education of teenagers translate into better survival knowledge, knowledge of skills, and adaptive behavioral change? A systematic literature review
11. **Costa et al. (2015)**	Costa Marco, Oberholzer-Riss Martin, Hatz Christoph, Steffen Robert, et al	Pre-travel health advice guidelines for humanitarian workers: A systematic review
12. **Petz (2015)**	Daniel Petz	Planned relocations in the context of natural disasters and climate change: a review of the literature.
13. **Dieltjens et al. (2014)**	Dieltjens T, Moonens I, Van Praet K, De Buck E, and Vandekerckhove P.	A systematic literature search on psychological first aid: lack of evidence to develop guidelines

Short title	Authors	Title
14.Ejeta et al. (2015)	Ejeta LT, Ardalan A, and Paton D	Application of Behavioral Theories to Disaster and Emergency Health Preparedness: A Systematic Review
15.Fox et al. (2012)	Fox JH, Burkle FM, Bass J, Pia FA, Epstein JL, and Markenson D	The Effectiveness of Psychological First Aid as a Disaster Intervention Tool: Research Analysis of Peer-Reviewed Literature From 1990-2010
16.Fu et al. (2015)	Fu C, and Underwood C	Disaster medicine and public health preparedness
17.Griffiths & Ford (2013)	Griffiths Karolina, and Ford Nathan	Provision of antiretroviral care to displaced populations in humanitarian settings: a systematic review
18.Heidaranlu et al. (2015)	Heidaranlu E, Ebadi A, Khankeh HR, and Ardalan A.	Hospital Disaster Preparedness Tools: a Systematic Review
19.Hopwood & Schutte (2016)	Hopwood Tanya L, and Schutte Nicola S	Psychological Outcomes in Reaction to Media Exposure to Disasters and Large-Scale Violence: A Meta-Analysis
20.Hsu et al. (2004)	Hsu EB, Jenckes MW, Catlett CL, Robinson KA, et al	Effectiveness of hospital staff mass-casualty incident training methods: a systematic literature review
21.Huntington & Gavagan (2011)	Huntington MK, and Gavagan TF	Disaster medicine training in family medicine: a review of the evidence
22.Johnsen et al. (2016)	Johnsen AS, Fattah S, Sollid SJ, and Rehn M	Utilisation of helicopter emergency medical services in the early medical response to major incidents: a systematic literature review
23.Johnson et al. (2014)	Johnson Victoria A, Ronan Kevin R, Johnston David M,	Evaluations of disaster education programs for children: A methodological review
24.Khan et al. (2015)	Khan F, Amatya B, Gosney J, Rathore FA, and Burkle FM	Medical Rehabilitation in Natural Disasters: A Systematic Review
25.Lebowitz (2015)	Lebowitz AJ	Community collaboration as a disaster mental health competency: a systematic literature review
26.Lipinski et al. (2016)	Lipinski K, Liu LL, and Wong PW	The effectiveness of psychosocial interventions implemented after the Indian Ocean Tsunami: A systematic review
27.Lopes et al. (2014)	Lopes AP, Macedo TF, Coutinho ES, Figueira I, and Ventura P	Systematic review of the efficacy of cognitive-behavior therapy related treatments for victims of natural disasters: a worldwide problem
28.Nekoie-Moghadam et al. (2016)	Nekoie-Moghadam M, Kurland L, Moosazadeh M, Ingrassia PL, et al	Tools and Checklists Used for the Evaluation of Hospital Disaster Preparedness: A Systematic Review

Short title	Authors	Title
29. Newman et al. (2014)	Newman E, Pfefferbaum B, Kirlic N, Tett R, Nelson S, and Liles B	Meta-analytic review of psychological interventions for children survivors of natural and man-made disasters
30. Ostadtaghizadeh et al. (2015)	Ostadtaghizadeh A, Ardalan A, Paton D, Jabbari H, and Khankeh HR	Community disaster resilience: a systematic review on assessment models and tools
31. Pega et al. (2015)	Pega F, Liu SY, Walter S, and Lhachimi SK	Unconditional cash transfers for assistance in humanitarian disasters: effect on use of health services and health outcomes in low- and middle-income countries
32. Sabina et al. (2012)	Sabina Fattah, Marius Rehn, Eirik Reierth, Torben Wisborg	Systematic literature review of templates for reporting prehospital major incident medical management
33. Sadeghi-Bazargani et al. (2015)	Sadeghi-Bazargani H, Azami-Aghdash S, Kazemi A, and Ziapour B	Crisis management aspects of bam catastrophic earthquake: review article
34. Horita et al. (2013)	Flávio E A. Horita, Lívia C Degrossi, et al	The use of Volunteered Geographic Information and Crowdsourcing in Disaster Management: a Systematic Literature Review
35. Akl et al. (2015)	Elie A Akl, Fadi El-Jardali, Lama Bou Karroum, and Jamale El-Eid et al	Mechanisms and Models of Coordination Between Organizations, Agencies and Bodies Providing or Financing Health Services in Humanitarian Crises: A Systematic Review
36. Shandiz et al. (2016)	Shandiz Moslehi, Ali Ardalan, William Waugh, et al	Characteristics of an Effective International Humanitarian Assistance: A Systematic Review
37. Doocy & Tappis, (2016)	Shannon Doocy, and Hannah Tappis	Cash-based approaches in humanitarian emergencies A systematic review
38. Soltani et al. (2014)	Soltani A, Ardalan A, Darvishi Boloorani A, Haghdoost A, and Hosseinzadeh-Attar MJ	Site selection criteria for sheltering after earthquakes: a systematic review
39. Timbie et al. (2013)	Timbie Justin W, Ringel Jeanne S, Fox D Steven, Pillemer Francesca, Waxman Daniel A et al	Systematic Review of Strategies to Manage and Allocate Scarce Resources During Mass Casualty Events
40. Uscher-Pines (2009)	Uscher-Pines Lori	Health effects of relocation following disaster: A systematic review of the literature
41. van Kessel (2014)	van Kessel G, MacDougall C, and Gibbs L.	Resilience-rhetoric to reality: a systematic review of intervention studies after disasters
42. Veenema et al. (2015)	Veenema TG, Rains AB, Casey-Lockyer M, Springer J, and Kowal M	Quality of healthcare services provided in disaster shelters: An integrative literature review

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43.Shawn et al. (2012)	Shawn S, Cole S, Bastian G, Wendel C, and Stein D	Systematic Review: The effectiveness of index-based micro-insurance in helping smallholders manage weather-related risks
44.Walsh et al. (2009)	Walsh DS	Interventions to reduce psychosocial disturbance following humanitarian relief efforts involving natural disasters: an integrative review
45.WHO (2013)	WHO	Interventions to reduce psychosocial disturbance following humanitarian relief efforts involving natural disasters: an integrative review
46.Zhong et al. (2014)	Zhong S, Clark M, Hou XY, Zang YL, and FitzGerald G	Progress and challenges of disaster health management in China: a scoping review
47.Scott et al. (2015)	Zoë Scott, Roger Few, Jennifer Leavy, Marcela Tarazona, et al	Strategic Research into National and Local Capacity Building for Disaster Risk Management

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APPENDICES

APPENDIX 1.1: SUMMARY OF THE HYOGO FRAMEWORK FOR ACTION 2005-2015:

Strategic Goals:

1. Effective integration of disaster risk reduction in to sustainable development policies, planning and programming at all levels
2. Development and strengthening of institutions, mechanisms, and capacities at all levels, in particular at the community level
3. Systematic incorporation of risk reduction approaches into the design and implementation of emergency preparedness, response, and recovery programs.

Priorities for action:

1. Ensuring disaster risk reduction is a national and a local priority with a strong institutional basis for implementation
2. Identifying, assessing and monitoring disaster risks and enhancing early warning
3. Using knowledge, innovation and education to build a culture of safety and resilience at all levels
4. Reducing the underlying risk factors
5. Strengthening disaster preparedness for effective response at all levels.

Targets:

1. Substantially reduce global disaster mortality by 2030
2. Substantially reduce the number of affected people globally by 2030
3. Reduce direct disaster economic loss in relation to global gross domestic product by 2030
4. Substantially reduce disaster damage to critical infrastructure and disruption of basic services, among them health and educational facilities, including through developing their resilience by 2030
5. Substantially increase the number of countries with national and local disaster risk reduction strategies by 2020
6. Substantially enhance international cooperation to developing countries through adequate and sustainable support to complement their national actions for implementation of the framework by 2030
7. Substantially increase the availability of and access to multi-hazard early warning systems and disaster risk information and assessments to the people by 2030.

Priority actions:

1. Understanding disaster risk
2. Strengthening disaster risk governance to manage disaster risk

3. Investing in disaster risk reduction for resilience
4. Enhancing disaster preparedness for effective response and to “Build Back Better” in recovery, rehabilitation and rehabilitation.

(United Nations, 2015)

APPENDIX 1.2: SENDAI FRAMEWORK FOR DISASTER RISK REDUCTION 2015 - 2030

Targets of the Framework:

1. Substantially reduce global disaster mortality by 2030
2. Substantially reduce the number of affected people globally by 2030
3. Reduce direct disaster economic loss in relation to global gross domestic product by 2030
4. Substantially reduce disaster damage to critical infrastructure and disruption of basic services, among them health and educational facilities, including through developing their resilience by 2030
5. Substantially increase the number of countries with national and local disaster risk reduction strategies by 2020
6. Substantially enhance international cooperation to developing countries through adequate and sustainable support to complement their national actions for implementation of the framework by 2030
7. Substantially increase the availability of and access to multi-hazard early warning systems and disaster risk information and assessments to the people by 2030.

Priority actions:

1. Understanding disaster risk
2. Strengthening disaster risk governance to manage disaster risk
3. Investing in disaster risk reduction for resilience
4. Enhancing disaster preparedness for effective response and to “Build Back Better” in recovery, rehabilitation and rehabilitation.

(United Nations, 2015)

APPENDIX 2.1: DEFINITIONS

Capacity: The combination of all the strengths, attributes and resources available within a community, society or organization that can be used to achieve agreed goals. (UNISDR, 2009)

Community Based Disaster Risk Management: Community-based Disaster Risk Management (CBDRM) is a process in which communities engage with the identification, analysis, mitigation, monitoring and evaluation of disaster risks in order to reduce their vulnerabilities and enhance their capacities (ADPC, 2003)

Disaster: A serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources. (UNISDR, 2009)

Disaster management: The organization and management of resources and responsibilities for dealing with all humanitarian aspects of emergencies, in particular preparedness, response and recovery in order to lessen the impact of disasters.

Disaster risk management: The systematic process of using administrative directives, organizations, and operational skills and capacities to implement strategies, policies and improved coping capacities in order to lessen the adverse impacts of hazards and the possibility of disaster. (UNISDR, 2009)

Disaster risk: The potential disaster losses, in lives, health status, livelihoods, assets and services, which could occur to a particular community or a society over some specified future time period. (UNISDR, 2009)

Evidence Summary: Evidence summaries are quality assured plain language summaries of the evidence available to answer important policy questions. They normally summarise the findings from systematic reviews of research in language accessible to non-specialists. (RFP, 2015)

Hazard: A dangerous phenomenon, substance, human activity or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage. (UNISDR, 2009)

Natural hazard: Natural process or phenomenon that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage. (UNISDR, 2009)

Recovery: The restoration, and improvement where appropriate, of facilities, livelihoods and living conditions of disaster-affected communities, including efforts to reduce disaster risk factors. (UNISDR, 2009)

Resilience: 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. (UNISDR, 2009)

Response: The provision of emergency services and public assistance during or immediately after a disaster in order to save lives reduces health impacts, ensure public safety and meet the basic subsistence needs of the people affected. (UNISDR, 2009)

South Asia: South Asian region (or South Asia) is understood as comprising of India, Pakistan, Bangladesh, Nepal, Afghanistan and Myanmar. (RFP, 2015)[7]

Vulnerability: The characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effects of a hazard. (UNISDR, 2009)

[7] South Asia is grouping of eight countries (India, Pakistan, Bangladesh, Afghanistan, Nepal, Bhutan, Sri Lanka and Maldives). Myanmar is a member of ASEAN which is an association of South East Asian Nations, but in the contexts of RFP South Asia includes India, Pakistan, Bangladesh, Nepal, Afghanistan and Myanmar

APPENDIX 2.2: POPULATION, INTERVENTION, COMPARISONS AND OUTCOMES (PICOS)

Language	**English**
Time Period	Post 1995
Phenomenon	Natural hazards • Floods • Landslide • Tropical Cyclone • Convective Storm • Forest Fire • Drought • Earthquake • Cold Wave • Heat Wave
Region/Countries	Low and middle income countries (LMICs)
Population	• Individuals, families and communities who are at risk or are vulnerable to disasters in low and middle income countries.
Intervention	Any disaster management intervention used at the country or regional level in low and middle-income countries. Relevant interventions will include, but may not be restricted to, the following[8]: • Community based disaster management approaches • Capacity building for disaster risk management • Public health Emergency Operation centres • Medical relief and rehabilitation interventions for relief and recovery • Cash based interventions (Unconditional or conditional cash transfers in case of humanitarian crisis) • Communication & information dissemination for disaster preparedness, rescue and recovery (through social media & Volunteered Geographic Information etc.) • Ecosystem-based approaches for adaptation (use of biodiversity and ecosystem services to help people adapt to the adverse effects of climate change and reduce risk of a disaster) • Mechanisms and models of coordination between organizations and agencies for relief activities These interventions could occur at different stages of a disaster: risk reduction, response, relief and recovery.
Comparison	Differential effects across: • Population groups (Ethnic, religious and other)

[8] The final set of interventions would depend upon the systematic reviews that are included in the evidence summary.

	• Rural/urban • state/ governments/communities, • gender, prior experience of disaster, age
Outcomes	Outcomes related to improvements in different aspects of disaster management across the four Rs of disaster. Relevant outcomes will include, but may not be restricted to, the following[9]: • ***Health outcomes*** (reduced mortality and/or morbidity, reduced diseases, functional restoration, improved symptoms/ impairments, • ***Knowledge outcomes*** (Information and awareness regarding disaster warning, vulnerability, disease outbreak, water contamination, vaccination, etc.) • ***Institutional changes*** (Changes to governance that result in a shift in thinking about disaster response to disaster prevention, CBDRM committees, Laws which institutionalize CBDRM, Mobilized resources for CBDRM) • ***Improved capacity to manage disaster risk & post disaster impact*** (Improved capacity of communities to respond to disasters, Existence of guidelines and procedures, Response team training) • ***Improved disaster prevention and management infrastructure*** (Availability of vulnerability information, disaster warning systems, access of the affected population to health services) • ***Efficient public health emergency services*** (Core response capacity, Incident action plan, action reports and improvement plans) • ***Socio economic outcomes*** (Individual and/or household level economic outcomes (such as utilization of cash, household assets or economic status, effect on local markets and infrastructure) • ***Behaviour change outcomes*** (higher compliance to health advice, voluntary information sharing) • ***Reduced risk and vulnerability of disaster*** (reduction in number of disasters and reduction in severity of disaster) ***Other sector specific outcomes*** (food security, availability of shelter, access to clean water, school enrolment)
Study Designs	Systematic reviews[10]

[9] The final outcomes would depend upon the systematic reviews that are included in the evidence summary.
[10] These include range of study designs such as evidence syntheses, meta-analyses, meta ethnography, meta narratives, meta reviews, realist reviews that fall within the definition of Systematic Review

APPENDIX 2.3: INFORMATION AND DATA SOURCES

Category 1: Electronic databases

- Pubmed
- Econlit
- ScienceDirect
- Social Science Abstract
- SSRN
- Psycinfo
- CAB Abstracts
- PAIS
- GEOBASE
- Web of Science (Social Science Citation index)

Category 2: Systematic Review databases

- Cochrane database of systematic reviews
- JBI
- EPPI-Centre systematic Reviews
- Campbell Collaboration
- DoPHER
- Evidence Aid
- Epistamonikas
- EVIPNET
- Oxfam review programme
- 3ie systematic reviews database
- Research 4 dfid
- 3ie evidence maps
- PLoS

Category 3: Websites

- Active Learning Network for Accountability and Performance in Humanitarian Action (ALNAP)
- Asian Disaster Preparedness Center (ADPC)
- Centre for Research on the Epidemiology of Disasters (CRED)
- Feinstein international
- Global Facility for Disaster Reduction and Recovery (GFDRR)
- Office of U.S. Foreign Disaster Assistance (OFDA)
- Preventionweb
- Reliefweb
- South Asian Disaster Knowledge Network
- UN Office for Disaster Risk Reduction (UNISDR)

Category 4: Websites and organizations

- DFID- R4D (Research for Development)
- International Centre for Integrated Mountain Development (ICIMOD)
- International Centre for Water Hazard and Risk Management (ICHARM)
- International Committee of the Red Cross (ICRC)
- International Institute for Environment and Development (IIED)
- Overseas Development Institute (ODI)
- UNDP
- UNEP
- UNHABITAT
- UNICEF
- World Health Organization (WHO)
- World Meteorological Organization (WMO)

APPENDIX 2.4: SEARCH TERMS

Sl. No.	Concept A – Study Design	Concept B - Phenomenon	Concept C - Intervention
1.	Evidence synthesis	Avalanche	adapt
2.	Meta analysis	Avalanches	adaptation
3.	Meta ethnography	blizzard	adaptive
4.	Meta narrative	bush fire	adaptive capacity
5.	Meta review	bushfire	aid
6.	Metaanalysis	climate change	capacity
7.	Realist review	Climate hazard	capacity building
8.	Review	climate variability	capacity development
9.	Reviews	cloud burst	CBDRM
10.	Synthesis	coastal hazard	CBRM
11.	Synthesise	cold wave	CBRR
12.	Systematic	cold waves	climate smart disaster risk management
13.	Systematic review	coldwave	community based disaster risk management
14.	Systematic reviews	coldwaves	community based disaster risk reduction
15.	Systematic search	cyclone	community based risk management
16.	Systematically	cyclones	community based risk reduction
17.	Systematized review	Cyclonic Storms	community participation
18.	Literature review	disaster	community planning
19.		disasters	community-based disaster risk management
20.		drought	community-based disaster risk reduction
21.		Droughts	cope

Sl. No.	Concept A – Study Design	Concept B - Phenomenon	Concept C - Intervention
22.		Earthquake	coping
23.		Earthquakes	coping capacity
24.		environment emergencies	cost effectiveness
25.		environmental catastrophe	CSDRM
26.		environmental emergency	damage
27.		extreme rainfall	DRM
28.		extreme weather	DRR
29.		extreme weather event	economic aspect
30.		Flood	effectiveness
31.		Flooding	emergency shelter
32.		Floodings	empowerment
33.		Floods	humanitarian
34.		forest fire	indigenous coping
35.		forest fires	indigenous knowledge
36.		forestfire	information
37.		forestfires	institution
38.		geological hazard	institutional
39.		Glacial lake outburst	international agencies
40.		GLOF	international cooperation
41.		hail storm	intervention
42.		hailstorm	livelihood
43.		heat wave	local authority
44.		heat waves	local government
45.		heatwave	local knowledge

Sl. No.	Concept A – Study Design	Concept B - Phenomenon	Concept C - Intervention
46.		heatwaves	loss
47.		intense rainfall	management
48.		irregular rainfall	micro-insurance
49.		lahar	mitigation
50.		lahars	municipality
51.		Landslide	planning
52.		Landslides	policy
53.		Mudslide	preparedness
54.		Mudslides	prevention
55.		natural catastrophe	reconstruction
56.		natural emergency	recovery
57.		Natural hazard	relief
58.		Rockslide	relief planning
59.		Rockslides	relief work
60.		sea level rise	rescue
61.		storm	rescue work
62.		storms	resilience
63.		Tidal Wave	resilient
64.		Tidal Waves	response
65.		Tidalwaves	risk
66.		Tsunami	risk analysis
67.		Tsunamis	risk assessment
68.		typhoon	risk management
69.		typhoons	risk planning

Sl. No.	Concept A – Study Design	Concept B - Phenomenon	Concept C - Intervention
70.		wild fire	risk reduction
71.		wildfire	risk resilience
72.		wildfires	settlement
73.		multi-hazard	social assistance
74.			social capital
75.			social protection
76.			societal
77.			traditional coping strategy
78.			traditional knowledge
79.			vulnerability
80.			vulnerable

APPENDIX 2.5: ILLUSTRATIVE SEARCH STRATEGY (PUBMED)

Search terms and fields	Results
(evidence synthesis*[Title] OR "meta analysis"[Title] OR "meta ethnography"[Title] OR "meta narrative"[Title] OR meta review*[Title] OR "metaanalysis"[Title] OR realist revie*[Title] OR revie*[Title] OR reviews*[Title] OR synthesi*[Title] OR synthesise*[Title] OR systematic[Title] OR systematic review*[Title] OR systematic review*[Title] OR systematic search*[Title] OR systematically*[Title] OR systematized review*[Title] OR literature review*[Title])	A-651535
(disaster[mh:noexp] OR ((Avalanche*[tiab] OR Avalanches*[tiab] OR blizzard*[tiab] OR bush fire*[tiab] OR bushfire*[tiab] OR climate change*[tiab] OR Climate hazard*[tiab] OR climate variability*[tiab] OR cloud burst*[tiab] OR coastal hazard*[tiab] OR cold wave*[tiab] OR cold waves*[tiab] OR coldwave*[tiab] OR coldwaves*[tiab] OR cyclone*[tiab] OR cyclones*[tiab] OR Cyclonic Storms*[tiab] OR disaster*[tiab] OR disasters*[tiab] OR drought*[tiab] OR Droughts*[tiab] OR Earthquake*[tiab] OR Earthquakes*[tiab] OR environmental catastrophe*[tiab] OR extreme rainfall*[tiab] OR "extreme weather" OR extreme weather event*[tiab] OR Flood*[tiab] OR Flooding*[tiab] OR Floodings*[tiab] OR Floods*[tiab] OR forest fire*[tiab] OR forest fires*[tiab] OR forestfire*[tiab] OR forestfires*[tiab] OR geological hazard*[tiab] OR hail storm*[tiab] OR hailstorm*[tiab] OR heat wave*[tiab] OR heat waves*[tiab] OR heatwave*[tiab] OR heatwaves*[tiab] OR intense rainfall*[tiab] OR irregular rainfall*[tiab] OR lahar OR lahars OR Landslide*[tiab] OR Landslides*[tiab] OR Mudslide*[tiab] OR Mudslides*[tiab] OR natural catastrophe*[tiab] OR Natural hazard*[tiab] OR Rockslide*[tiab] OR Rockslides*[tiab] OR sea level rise*[tiab] OR storm*[tiab] OR storms*[tiab] OR Tidal Wave*[tiab] OR Tidal Waves*[tiab] OR Tidalwaves*[tiab] OR Tsunami*[tiab] OR Tsunamis*[tiab] OR typhoon*[tiab] OR typhoons*[tiab] OR wild fire*[tiab] OR wildfire*[tiab] OR wildfires*[tiab] OR "GLOF" [tiab] OR "Glacial lake outburst" [tiab] OR (emergencies[tiab] AND (natural[tiab] OR environment[tiab] OR environmental[tiab])))))	B-83779

(("relief work"[mh] OR "rescue work"[mh] OR "emergency shelter"[mh] OR ((adapt*[tiab] OR adaptatio*[tiab] OR adaptive*[tiab] OR adaptive capacity*[tiab] OR aid*[tiab] OR capacity*[tiab] AND (building*[tiab] OR development*[tiab]) OR CBDRM*[tiab] OR CBRM*[tiab] OR CBRR*[tiab] OR cope*[tiab] OR coping*[tiab] OR coping capacity*[tiab] OR cost effectiveness*[tiab] OR damage*[tiab] OR DRM*[tiab] OR DRR*[tiab] OR economic aspect*[tiab] OR effectiveness*[tiab] OR empowerment*[tiab] OR humanitarian*[tiab] OR indigenous coping*[tiab] OR indigenous knowledge*[tiab] OR information*[tiab] OR international agenci*[tiab] OR international cooperation*[tiab] OR intervention*[tiab] OR livelihood*[tiab] OR local authority*[tiab] OR local government*[tiab] OR local knowledge*[tiab] OR loss*[tiab] OR management*[tiab] OR mitigation*[tiab] OR municipality*[tiab] OR planning*[tiab] OR preparedness*[tiab] OR prevention*[tiab] OR reconstruction*[tiab] OR recovery*[tiab] OR Relief*[tiab] OR Relief Planning*[tiab] OR resilience*[tiab] OR resilient*[tiab] OR response*[tiab] OR risk*[tiab] OR risk analysis*[tiab] OR risk assessment*[tiab] OR risk management*[tiab] OR risk planning*[tiab] OR risk reduction*[tiab] OR risk resilience*[tiab] OR settlement*[tiab] OR "social assistance" OR social capital*[tiab] OR social protection*[tiab] OR societal*[tiab] OR traditional coping strategy*[tiab] OR traditional knowledge*[tiab] OR vulnerability*[tiab] OR "vulnerable" OR polic*[tiab] OR instituti*[tiab] OR institutional*[tiab] OR (communit*[tiab]AND (disaster risk management[tiab] OR disaster risk reduction*[tiab] OR risk management*[tiab] OR participation*[tiab] OR planning*[tiab])))))	C-7222504
Final search results	**A+B+C=923**

APPENDIX 2.6 INCLUSION EXCLUSION CRITERIA

(A) Title and abstract screening (with full text used as needed)

Category	Criterion	Decision
Language	Published in English or title and abstract available in English	Yes or maybe →Continue No →Exclude
Publication date	Published in 1995 or later	Yes or maybe →Continue No →Exclude
Region/Country	All countries	Yes or maybe →Continue No →Exclude
Population	-	Include all
Phenomenon	natural disasters	Yes or maybe →Continue No →Exclude
Intervention/Phenomenon	Intervention to manage any of the four stages of natural disasters	Yes or maybe →Continue No →Exclude
Outcome	-	Include all
Study design	Studies that satisfy the definition of systematic review	Yes or maybe →Continue No →Exclude
	Is it a completed study and not a protocol	Yes or maybe →Continue No →Exclude

Exclusion criteria

Category	Criterion	Decision
Phenomenon	Volcanic eruption and man-made disasters	Yes →Exclude No or may be not→Continue
Study design	A protocol or literature review which does not satisfy the definition of a systematic review	Yes →Exclude No or may be not→Include

(B) Full-text screening

Category	Criterion	Decision
Study Design	Uses at least 2 databases in the review	Yes →Continue No →Exclude
	Specifies Inclusion and Exclusion Criteria	Yes →Continue No →Exclude
Region/Country	All countries	Yes or maybe →Continue No →Exclude

Intervention/Phenomenon	Intervention to manage any of the four stages of natural disasters	Yes No	→Continue →Exclude

APPENDIX 2.7 DATA EXTRACTION TOOL

Study ID	**Author/s (Year)**	
Year of Publication	Post 1995	
Region	Low income/Lower middle income/Upper middle income/ High income	
Country/Region	select from list of LMICs	
Types or Aim of SR	• Systematic review or review of effectiveness of Disaster Management interventions • SR of use or aspect of DM intervention or strategies of implementation • SR or review of effectiveness of broad interventions including DM • SR of barriers /facilitators for DM interventions • SR or review of DM needs assessment and care plans • Systematic map or scoping review of DM interventions • Systematic review of reviews on DM interventions • SR of research on DM interventions	
Population Group	Age Group	Children & Young people only / Adult only / Other Adults / No specific age group focused
	Gender	Female only / Male only / No specific focus on gender
	Rural/Urban	Rural / Urban / No specific focus
Types of natural hazards	Floods, Landslide, Cyclone, Convective Storm, Forest Fire, Drought, Earthquake, Cold Wave, Heat Wave, Hurricane, Tornado, Tsunami, Typhoons, Other, Not Specified /broad all natural disasters	
Geographical Context	• LMIC • HIC • No geographical focus (LMIC and HIC)	
Intervention-Type according to disaster phase addressed in the review	• Risk mitigation (disaster prevention) • Response Readiness (disaster planning & preparedness) • Response Execution (disaster relief) • Recovery (disaster recovery)	
Intervention type included in the review (please specify)	• Adaptation measure • Behavioral theories and models • Capacity, education and training • Cash based interventions • Communication and information	

	• Community based management • Crisis management • Emergency Management and Infrastructure • Health systems approach • Healthcare • Insurance • International Humanitarian Assistance • Mechanisms and models of coordination • Medical interventions and Rehabilitation • Preparedness tools and guidelines • Relocation • Reporting and monitoring • Strategies to manage and allocate scarce resources
Number of studies included in the review	N = Add
Study design of included studies	• RCT's only • RCT's and Non-RCT's • All study types • Not clearly reported
Comparator	• With government mechanism v. non-government • Females v. Males • High income v. Low income • High caste v. Low caste • Other
Outcome/s	• Health outcomes • Knowledge outcomes • Institutional changes • Improved disaster prevention and management infrastructure • Efficient public health emergency services • Socio economic outcomes • Behaviour change outcomes • Reduced risk and vulnerability of disaster • Other sector specific outcomes • None reported
Type of Synthesis	• Meta-analysis • Numerical narrative • Narrative • No synthesis

Result/ Concluding statement	• Positive evidence of effect • No difference of effect • Evidence of harm • Inconclusive evidence • Insufficient evidence • Narrative conclusion

APPENDIX 2.8: DATA CODING AND EXTRACTION TOOL – FOR ASSESSING QUALITY OF STUDIES

"A MeaSurement Tool to Assess systematic Reviews" (AMSTAR) was used to evaluate quality and decide whether or not a particular review should be used in the evidence summary or not.

Criterion	Assessment	Number of reviews
1. Was an 'a priori' design provided? **The research question and inclusion criteria should be established before the conduct of the review.** ***Note: Need to refer to a protocol, ethics approval, or pre-determined/a priori published research objectives to score a "yes."***	Yes No Can't answer Not applicable	21 13 15
2. Was there duplicate study selection and data extraction? **There should be at least two independent data extractors and a consensus procedure for disagreements should be in place.** ***Note: 2 people do study selection, 2 people do data extraction, consensus process or one person checks the other's work.***	Yes No Can't answer Not applicable	17 15 17
3. Was a comprehensive literature search performed? **At least two electronic sources should be searched. The report must include years and databases used (e.g., Central, EMBASE, and MEDLINE). Key words and/or MESH terms must be stated and where feasible the search strategy should be provided. All searches should be supplemented by consulting current contents, reviews, textbooks, specialized registers, or experts in the particular field of study, and by reviewing the references in the studies found.** ***Note: If at least 2 sources + one supplementary strategy used, select "yes" (Cochrane register/Central counts as 2 sources; a grey literature search counts as supplementary).***	Yes No Can't answer Not applicable	47 2
4. Was the status of publication (i.e. grey literature) used as an inclusion criterion? **The authors should state that they searched for reports regardless of their publication type. The authors should state whether or not they excluded any reports (from the systematic review), based on their publication status, language etc.** ***Note: If review indicates that there was a search for "grey literature" or "unpublished literature," indicate "yes." SIGLE database, dissertations, conference proceedings, and trial registries are all considered grey for this purpose. If searching a source that***	Yes No Can't answer Not applicable	27 19 3

	contains both grey and non-grey, must specify that they were searching for grey/unpublished lit.		
5.	Was a list of studies (included and excluded) provided? **A list of included and excluded studies should be provided.** ***Note: Acceptable if the excluded studies are referenced. If there is an electronic link to the list but the link is dead, select "no."***	Yes No Can't answer Not applicable	43 6
6.	Were the characteristics of the included studies provided? I**n an aggregated form such as a table, data from the original studies should be provided on the participants, interventions and outcomes. The ranges of characteristics in all the studies analyzed e.g., age, race, sex, relevant socioeconomic data, disease status, duration, severity, or other diseases should be reported.** ***Note: Acceptable if not in table format as long as they are described as above.***	Yes No Can't answer Not applicable	46 3
7.	Was the scientific quality of the included studies assessed and documented? **'A priori' methods of assessment should be provided (e.g., for effectiveness studies if the author(s) chose to include only randomized, double-blind, placebo controlled studies, or allocation concealment as inclusion criteria); for other types of studies alternative items will be relevant.** ***Note: Can include use of a quality scoring tool or checklist, e.g., Jadad scale, risk of bias, sensitivity analysis, etc., or a description of quality items, with some kind of result for EACH study ("low" or "high" is fine, as long as it is clear which studies scored "low" and which scored "high"; a summary score/range for all studies is not acceptable).***	Yes No Can't answer Not applicable	21 28
8.	Was the scientific quality of the included studies used appropriately in formulating conclusions? **The results of the methodological rigor and scientific quality should be considered in the analysis and the conclusions of the review, and explicitly stated in formulating recommendations.** ***Note: Might say something such as "the results should be interpreted with caution due to poor quality of included studies." Cannot score "yes" for this question if scored "no" for question 7.***	Yes No Can't answer Not applicable	21 28
9.	Were the methods used to combine the findings of studies appropriate? **For the pooled results, a test should be done to ensure the studies were combinable, to assess their homogeneity (i.e., Chi-squared test for homogeneity, I2). If heterogeneity exists a random effects model should be used**	Yes No Can't answer	49

	and/or the clinical appropriateness of combining should be taken into consideration (i.e., is it sensible to combine?). ***Note: Indicate "yes" if they mention or describe heterogeneity, i.e., if they explain that they cannot pool because of heterogeneity/variability between interventions.***	Not applicable	
10.	Was the likelihood of publication bias assessed? **An assessment of publication bias should include a combination of graphical aids (e.g., funnel plot, other available tests) and/or statistical tests (e.g., Egger regression test, Hedges-Olken).** ***Note: If no test values or funnel plot included, score "no". Score "yes" if mentions that publication bias could not be assessed because there were fewer than 10 included studies.***	Yes No Can't answer Not applicable	18 14 7 10
11.	Was the conflict of interest included? **Potential sources of support should be clearly acknowledged in both the systematic review and the included studies.** ***Note: To get a "yes," must indicate source of funding or support for the systematic review AND for each of the included studies.***	Yes No Can't answer Not applicable	36 13
FINAL Score out of 11			

APPENDIX 2.9: BREAKDOWN OF QUALITY APPRAISAL JUDGMENT

S No.	Review	Criteria 1: Was an "a priori" design provided?	Criteria 2: Was there duplicate study selection and data extraction ?	Criteria 3: Was a comprehe nsive literature search performed ?	Criteria 4: Was the status of publication (i.e. grey literature) used as an inclusion criterion?	Criteria 5: Was a list of studies (included and excluded) provided?	Criteria 6: Were the characteristi cs of the included studies provided?	Criteria 7: Was the scientific quality of the included studies assessed and documented ?	Criteria 8: Was the scientific quality of the included studies used appropriate ly in formulating conclusions ?	Criteria 9: Were the methods used to combine the findings of studies appropriate ?	Criteria 10: Was the likelihood of publication bias assessed?	Criteria 11: Was the conflict of interest included ?	Over all Scor e
1	Babaie J et al.	Y	N	Y	Y	Y	Y	N	NA	Y	NA	Y	7
2	Bagaria J et al.	CA	CA	Y	Y	N	Y	N	NA	Y	NA	N	4
3	Bayntun C	Y	N	Y	N	Y	Y	Y	Y	Y	NA	Y	9
4	Becker Dawn et al.	N	Y	Y	Y	Y	Y	N	NA	Y	N	N	6
5	Boeckmann M et al.	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	11
6	Brink E et al.	Y	Y	Y	N	Y	Y	N	NA	Y	Y	Y	8
7	Challen K et al.	N	Y	Y	Y	N	Y	N	NA	Y	Y	Y	7
8	Chu TA et al.	N	CA	Y	Y	Y	Y	N	NA	Y	Y	Y	7
9	Codreanu TA et al.	N	Y	Y	Y	Y	Y	Y	Y	Y	CA	Y	9
10	Costa M et al.	N	N	Y	N	Y	Y	N	NA	Y	NA	Y	5
11	Daniel Petz	N	N	Y	Y	Y	Y	N	NA	Y	NA	Y	6
12	Dieltjens T et al.	N	N	Y	N	Y	Y	N	NA	Y	NA	Y	5
13	Ejeta LT et al.	Y	CA	Y	Y	Y	Y	Y	Y	Y	Y	Y	10

S No.	Review	Criteria 1: Was an "a priori" design provided?	Criteria 2: Was there duplicate study selection and data extraction ?	Criteria 3: Was a comprehensive literature search performed ?	Criteria 4: Was the status of publication (i.e. grey literature) used as an inclusion criterion?	Criteria 5: Was a list of studies (included and excluded) provided?	Criteria 6: Were the characteristics of the included studies provided?	Criteria 7: Was the scientific quality of the included studies assessed and documented ?	Criteria 8: Was the scientific quality of the included studies used appropriately in formulating conclusions ?	Criteria 9: Were the methods used to combine the findings of studies appropriate ?	Criteria 10: Was the likelihood of publication bias assessed?	Criteria 11: Was the conflict of interest included ?	Overall Score
14	Fox JH et al.	N	CA	Y	CA	N	N	N	NA	Y	N	Y	4
15	Fu C et al.	N	CA	Y	N	Y	Y	N	NA	Y	Y	N	5
16	Griffiths K et al.	N	N	Y	Y	Y	Y	Y	Y	Y	Y	N	8
17	Heidaranalu E et al.	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	9
18	Hopwood T L et al.	Y	Y	Y	N	Y	Y	N	NA	Y	Y	N	7
19	Hsu EB et al.	CA	Y	Y	N	Y	Y	N	NA	Y	NA	N	5
20	Huntington MK et al.	N	N	Y	N	Y	Y	N	NA	Y	N	N	4
21	Johnsen AS et al.	Y	N	Y	N	Y	Y	Y	Y	Y	NA	Y	8
22	Johnson VA et al.	CA	CA	Y	Y	Y	Y	N	NA	Y	N	Y	6
23	Khan F et al.	CA	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	10
24	Lebowitz AJ	CA	CA	Y	Y	Y	Y	N	NA	Y	CA	Y	6
25	Lipinski k et al.	Y	CA	Y	Y	Y	Y	Y	Y	Y	CA	Y	9
26	Lopes AP et al.	CA	CA	Y	Y	Y	Y	Y	Y	Y	NA	Y	8

S No.	Review	Criteria 1: Was an "a priori" design provided?	Criteria 2: Was there duplicate study selection and data extraction ?	Criteria 3: Was a comprehensive literature search performed ?	Criteria 4: Was the status of publication (i.e. grey literature) used as an inclusion criterion?	Criteria 5: Was a list of studies (included and excluded) provided?	Criteria 6: Were the characteristics of the included studies provided?	Criteria 7: Was the scientific quality of the included studies assessed and documented ?	Criteria 8: Was the scientific quality of the included studies used appropriately in formulating conclusions ?	Criteria 9: Were the methods used to combine the findings of studies appropriate ?	Criteria 10: Was the likelihood of publication bias assessed?	Criteria 11: Was the conflict of interest included ?	Overall Score
27	Nekoie-Moghadam M et al.	Y	Y	Y	CA	Y	Y	N	NA	Y	CA	N	6
28	Newman E et al.	CA	CA	Y	N	Y	Y	N	NA	Y	N	Y	5
29	Ostadtaghizadeh A et al.	Y	CA	Y	N	Y	Y	N	NA	Y	N	Y	6
30	Pega F et al.	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	11
31	Sabina et al.	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	9
32	Sadeghi-Bazargani H et al.	CA	CA	Y	N	Y	Y	Y	Y	Y	CA	Y	7
33	Flavio E A et al.	Y	CA	Y	N	Y	Y	N	NA	Y	NA	Y	6
34	Bradley DT et al.	Y	Y	Y	Y	Y	Y	N	NA	Y	Y	Y	9
35	Elie A Akl et al.	Y	Y	Y	CA	Y	Y	Y	Y	Y	Y	Y	10
36	Shandiz Moslehi et al.	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	10
37	Doocy et al.	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	11
38	Soltani A et al.	Y	N	Y	N	Y	Y	N	NA	Y	Y	Y	7

S No.	Review	Criteria 1: Was an "a priori" design provided?	Criteria 2: Was there duplicate study selection and data extraction ?	Criteria 3: Was a comprehensive literature search performed ?	Criteria 4: Was the status of publication (i.e. grey literature) used as an inclusion criterion?	Criteria 5: Was a list of studies (included and excluded) provided?	Criteria 6: Were the characteristics of the included studies provided?	Criteria 7: Was the scientific quality of the included studies assessed and documented ?	Criteria 8: Was the scientific quality of the included studies used appropriately in formulating conclusions ?	Criteria 9: Were the methods used to combine the findings of studies appropriate ?	Criteria 10: Was the likelihood of publication bias assessed?	Criteria 11: Was the conflict of interest included ?	Overall Score
39	Timbie Justin et al.	CA	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	9
40	Uscher-Pines Lori	N	CA	Y	N	Y	Y	N	NA	Y	CA	N	4
41	van Kessel G et al.	CA	CA	Y	Y	Y	Y	Y	Y	Y	Y	N	8
42	Veenema TG et al.	CA	Y	Y	N	Y	Y	Y	Y	Y	N	N	7
43	Shawn S et al.	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	9
44	Walsh DS	CA	CA	Y	Y	Y	Y	N	NA	Y	N	N	5
45	WHO	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	10
46	Willems A et al.	CA	N	N	Y	N	N	N	NA	Y	N	Y	3
47	Williams J et al.	CA	N	N	Y	N	N	N	N	NA	Y	Y	3
48	Zhong S et al.	N	Y	Y	N	N	Y	N	NA	Y	CA	Y	5
49	Zoe Scott et al.	CA	CA	Y	N	Y	Y	N	NA	Y	N	Y	5

APPENDIX 3.1: EVIDENCE OF EFFECTIVENESS

MEDICAL INTERVENTIONS AND REHABILITATION

One of the most common medical interventions in the reviews included in this evidence summary was mental health and psycho-social (MHPSS) interventions. These included psychological first aid, including treatment standards, treatment guidelines, and treatment options (Fox et al., 2012); Cognitive Behavioral Therapy (CBT) Psychological Debriefing/Crisis Intervention and Spiritual-Hypnosis Assisted Treatment (Newman et al., 2014). Five reviews covered the last two stages of DM, i.e., response execution and recovery (Babaie et al., 2015; Becker et al., 2016; Fu & Underwood, 2015; Griffiths & Ford, 2013; Lipinski et al., 2016). Three SRs studied interventions such as psychological first aid and medical rehabilitation programmes for response execution (Dieltjens et al., 2014; Fox et al., 2012; Khan et al., 2015). Three SRs reviewed interventions such as cognitive-behavior therapy, CBT, psychological debriefing/crisis intervention and psychosocial interventions for longer term recovery post disaster (Lopes et al., 2014; Newman et al., 2014, Walsh, 2009).

Psychosocial interventions, including psychosocial care; mixed psycho educational, CBT, ART; Narrative exposure therapy and meditation relaxation therapy; mixed stress debriefing, team building etc. were examined in two reviews. One SR studied the impact of interventions on population directly affected by disasters (Lipinski et al., 2016), and the other review was for relief workers (Walsh, 2009).

In addition, there were other psychological care programmes, such as school based post disaster mental health and psychological interventions for youth (e.g. psycho education, cognitive behaviour techniques, reconstruction of trauma experiences and stress management skills)(Fu & Underwood, 2015); Psychological care and mental health programmes with social activity programmes, and rehabilitation programmes (Khan et al., 2015).

Communicable disease surveillance (Babaie et al., 2015), use of hand-carried and hand-held ultrasound for patient diagnosis and management at response execution and recovery stages (Becker et al., 2016), and provision of antiretroviral care to displaced populations are other important medical interventions covered in the systematic reviews (Griffiths & Ford, 2013).

All the medical interventions were reviewed for disaster response execution and recovery.

OUTCOME

Eight out of 11 SRs on medical interventions aimed at reviewing effectiveness (Dieltjens et al., 2014; Fox et al., 2012; Fu et al., 2015, Griffiths & Ford, 2013; Khan et al., 2015; Lipinski et al., 2016; Lopes et al., 2014; Newman et al., 2014). 4 SRs use aspects of disaster management intervention or strategies of implementation (Babaie et al., 2015; Becker et al., 2016; Fu et al., 2015; Walsh, 2009), and two reviewed barriers or facilitators for disaster management interventions (Griffiths & Ford, 2013; Newman et al., 2014). The main outcomes discussed and reported for medical interventions are health and socio-economic related.

The most reviewed effect of medical interventions was in terms of **health outcomes** addressing both physical and psychological health.

Since seven out of eleven medical interventions were in the nature of psychological aid or psychosocial aid, their outcomes were reported for mental health, such as improved mental health with access to psychological first aid after a disaster, improved mental and psychological health, reduction in frequency and symptoms of post trauma stress disorder (PTSD) (Lipinski et al., 2016; Walsh, 2009), and overall psychological well-being (Newman et al., 2014; Lopes et al., 2014). One review examined psychological care as a part of overall medical rehabilitation programme, comprising mental health programme, social activity programme and rehabilitation programmes. This review reported positive effects by way of functional restoration, improved symptoms / impairments, participation), health care processes, safety (Khan et al., 2015).

Antiretroviral therapy and care to displaced populations is shown to have a positive effect on follow up, patient retention and reduced mortality (Griffiths & Ford, 2013). Hand-carried and hand-held ultrasound devices can potentially be effective for improved diagnosis and management of patients (Becker et al., 2016). Communicable disease surveillance may be useful to control disease outbreak (Babaie et al., 2015).

Other possible effects of medical rehabilitation programme for disaster management are for **socio economic** determinants - quality of life and social reintegration. (Khan et al., 2015)

CAPACITY, EDUCATION AND TRAINING

Six reviews dealt with building capacity, education and training of population of different age groups, vulnerabilities and skillsets.

Two reviews examined education programmes for schoolchildren and teenagers. One covered all the four stages of disaster management (Johnson et al., 2014), while another covered risk mitigation and response readiness only (Codreanu et al., 2014). One review focused on capacity building for risk mitigation building capacity at national and local levels to strengthen the competencies and skills of different target groups (Scott et al., 2015).

A training programme for hospital staff was also reviewed where use of disaster drills, technology-based interventions and table-top exercises in training hospital staff to respond to a mass casualty incident was examined (Hsu et al., 2004). Disaster medicine is another intervention that was reviewed for improving response readiness and response execution (Huntington & Gavagan, 2011, Lebowitz, 2015).

OUTCOME

Five SRs on capacity building and training interventions reviewed effectiveness (Codreanu et al., 2014; Hsu et al., 2004; Huntington & Gavagan, 2011; Johnson et al., 2014; Scott et al., 2015). One SR reviewed cooperation and collaboration in disaster mental health competency literature (Lebowitz, 2015) and one reviewed barriers or facilitators for disaster management interventions (Scott et al., 2015).

Capacity building approaches to disaster management are reported to have four kinds of outcome – knowledge outcome; improved capacity to manage disaster risk and post disaster impact; reduced risk and vulnerability; and behavioural change.

Knowledge creation, enhancement and retention are evident effects of capacity building approaches. Of the included reviews, two reported **knowledge outcomes** for school children and one for disaster health professionals. Disaster education programmes for teenagers were reported to have some evidence of increasing theoretical disaster knowledge that can be extended to practical skills (Codreanu et al., 2014). Positive evidence of knowledge outcomes - knowledge of hazard risks, knowledge of protective actions during an emergency, knowledge of mitigation actions, knowledge of recovery actions – as a result of school based disaster education programme was reported in one more review (Johnson et al., 2014).

There is a varied degree of evidence of the extent to which education and training programmes **improve capacity to manage disaster risk and post disaster impacts**. One review reported positive capacity outcomes (household preparedness) associated with disaster education programs for children (Johnson et al., 2014).

Hospital disaster drills can be useful in training hospital staff to respond to a mass casualty incident as a result of a disaster. Hospital disaster drills were seen as effective in familiarizing hospital employees with disaster procedures and response components (incident command, triage, patient flow, communication, and security) (Hsu et al., 2004).

Training medical professionals in disaster medicine and dedicated efforts for enhancing the competence of specific organisations, group or community can also improve capacity to manage disaster risk and improve resilience. However, the two reviews studying this intervention and outcome report insufficient evidence to prove effectiveness (Scott et al., 2015; Huntington & Gavagan, 2011).

Behavioural change in vulnerable or affected population can be another result of education and training programmes. Change in behaviour, as reported in reviews, could be for better preparedness, including attitudes, confidence and anxiety levels. The two reviews examining education programmes for school children found insufficient evidence in this respect (Codreanu et al., 2014; Johnson et al., 2014).

EMERGENCY MANAGEMENT AND INFRASTRUCTURE

One scoping review identified and analysed literature on emergency planning, which was then categorized into mitigation, hazard analysis, capability assessment, emergency planning, capability maintenance, emergency response, recovery, development plans, communications/mass media, informatics and intelligence, and other organisational issues (Challen et al., 2012).

Three reviews related to emergency management and infrastructure for hospitals and medical services. One review focused on helicopter emergency medical services (HEMS) in early pre-hospital phase of a major incident, including natural disasters. HEMS were used for patient evacuation and transport from scene, transport of supplies, personnel and equipment the disaster affected location (Johnsen et al., 2016).

Public health emergency operations centre (EOC), or a ‘central location for coordinating operational information and resources for strategic management of public health emergencies and events’, was systematically reviewed by a WHO report for disaster response execution (WHO, 2013).

Two reviews explored evacuation and sheltering policies and practices. While one review studied hospital evacuation and sheltering policies in hospitals during emergencies (response readiness and response execution), another review explored site selection criteria that need to be considered for emergency and temporary shelters for affected population after earthquakes (Soltani et al., 2014).

OUTCOME

Out of the five reviews on emergency management and infrastructure, three discussed different aspects of an intervention without reporting on any outcome (Bagaria et al., 2009; Soltani et al., 2014; WHO, 2013).

Helicopter emergency medical services were reviewed in relation to early medical management of major incidents but evidence was found to be insufficient in evaluating the role of HEMS in **efficient public health emergency services** (Johnsen et al., 2016).

Improved capacity to manage disaster risk as a result of emergency planning and response was discussed in a scoping review for response readiness (Challen et al., 2012).

COMMUNICATION AND INFORMATION

Effective communication and uninterrupted information flows are important for disaster management across all the four phases. One SR studied risk communication interventions across all the four Rs of disaster management. These included face-to-face, television, radio, Internet or telephone communication, or any other method of risk communication aimed at informing the public about a potential disaster situation (Bradley et al). While the review anticipated employment of modern means of communication, such as internet based social media, it did not include any study on internet communication in its synthesis.

Another review established that evidence of use of Volunteered Geographic Information and Crowdsourcing in disaster management has grown over the last few years. It found that the most studies were predominantly on disaster response, with fewer studies on mitigation and preparedness, and none on recovery (Horita et al., 2013).

Media exposure, through means such as television, newspapers, radio and internet during response execution or relief in a natural disaster was reviewed in one meta-analysis (Hopwood & Schutte, 2016).

OUTCOME

Two SRs studied effects of communication interventions in disaster settings (Hopwood & Schutte, 2016; Bradley et al., 2014). Hopwood and Schutte (2016) reported on the effect of media exposure to disasters on **psychological health**. Bradley et al. (2014) reported on **health outcomes, behavioral outcomes** and **reduced risk and vulnerability** for risk communication interventions.

One review that assessed the current state of use of Volunteered Geographic Information (VGI) to aid the management of disasters did not report with respect to any outcomes (Horita et al., 2013).

PREPAREDNESS TOOLS AND GUIDELINES

All three reviews on preparedness tools and guidelines were specifically for the response readiness phase of disaster management. Two reviews assessed tools to evaluate and measure hospital preparedness focusing on all the relevant characteristics and properties of a tool (Heidaranlu et al., 2015, Nekoie-Moghadam et al., 2016). One review pertained to pre-travel health advice guidelines for humanitarian workers. (Costa et al., 2015)

OUTCOME

Standard, comprehensive and reliable tools to measure disaster preparedness of hospitals have the potential to **improve disaster prevention and management infrastructure** (Nekoie-Moghadam et al., 2016). Pre-travel health advice guidelines for humanitarian workers can have the potential to **improve capacity to manage disaster risk** as a result of better and informed preparation by aid workers prior to deployment in disaster settings (Costa et al., 2015).

No outcome was reported for hospital disaster preparedness tools (Heidaranlu et al., 2015).

ADAPTATION MEASURE

For risk mitigation, one review assessed the evidence on heat adaptation and heat prevention measures, such as heat warning systems (including awareness and communication), air conditioning etc. conducted in an urban area (Boeckmann & Rohn, 2014). Another paper undertook a systematic review of Ecosystem based Adaptation (EBA) research in urban environments. It defined EBA as 'use of the range of opportunities for the sustainable management, conservation and restoration of ecosystems to provide services that enable people to adapt to the impacts of climate change. It aims to maintain and increase the resilience and reduce the vulnerability of ecosystems and people in the face of the adverse effects of climate change. Ecosystem-based adaptation is most appropriately integrated into broader adaptation and development strategies' (Brink et al., 2016). Both of the adaptation measures were reviewed in the urban context.

OUTCOME

One review evaluated the impact of heat adaptation measures on **health** - heat-related morbidity and mortality, by measuring reduction in heat stroke incidence, hospitalization for heat-related illness, mortality induced by respiratory and other causes in extreme heat events (Boeckmann & Rohn, 2014) .The evidence, however, was found to be inconclusive.

CASH BASED INTERVENTIONS

Cash based interventions for disaster management were studied for disaster relief and recovery by two systematic reviews (Pega et al., 2015, Doocy & Tappis, 2016). Both of the reviews examined different forms of cash based mechanisms such as unconditional cash transfer for assistance, conditional cash transfer and voucher programmes for affected populations in low and middle income countries.

OUTCOME

While both the reviews reported **socio-economic outcomes** (such as utilization of cash, household assets or economic status, social determinants of health, and local markets and infrastructure), they found the evidence to be either insufficient or inconclusive. Inconclusive evidence was also found for health services and **health outcomes** (Pega et al., 2015). Evidence for **improved capacity to manage disaster risk & post disaster impact** by improving coping mechanism was found to be inadequate. Positive evidence was, however, found for **sector outcomes** such as ensuring household food security among drought-affected populations (Doocy et al., 2016).

COMMUNITY BASED MANAGEMENT

Various forms of community based resilience interventions were reviewed for people after they had experienced a disaster (Kessel et al., 2014). The interventions include resilience supported through social integration, information in the form of documentary, leaflets to help prepare for disasters; radio transmission providing information; recreational activities; capacity building through linking with peers and establishing collective action groups, participatory education and assistance in generating financial capital (Kessel et al., 2014). Another study reviewed resilience concepts and the tools, models, and methods adopted for measurable domains for community disaster – the main domains include social, economic, institutional, physical, and natural (Ostadtaghizadeh et al., 2015).

OUTCOME

One of the reviews assessed effectiveness of community-based resilience interventions on **health outcomes** in adult population after disasters, but found low level of evidence meeting its criteria (Kessel et al., 2014). The other review on community based disaster management discussed the potential of evaluation of community based resilience in making informed disaster risk reduction strategies; it neither aimed at nor offered any evaluation of effectiveness (Ostadtaghizadeh et al., 2015).

HEALTHCARE

One study examined the scope and quality of health care services rendered in disaster and emergency shelters and included interventions such as staffing and preparedness, medications/ medication management, infection control, referrals, communication, and mental health. Although the geographical focus of the review was US and Japan, these healthcare interventions are nevertheless important (Veenema et al., 2015). Another healthcare related scoping review gave an overview of the health disaster response system in China providing urgent health interventions and ongoing health care during and after disasters (Zhong et al., 2014).

One systematic review discussed improved **health outcomes** experienced by residents in emergency disaster sheltering in United States of America and Japan (Veenema et al., 2015). It found systematic outcomes-based literature in this area to be ‘notably sparse’. A scoping review looked at impact of healthcare in during and after disasters on strengthening **health disaster response system** in China. (Zhong et al., 2014)

RELOCATION

The two SRs related to relocation were primarily systematic literature reviews. They studied anticipatory as well as reactive relocation of disaster affected populations at response execution and recovery stages (Petz, 2015; Uscher-Pines, 2009).

OUTCOME

Two reviews studied effects of relocation of disaster affected and vulnerable populations. One review aimed at reviewing effects of post disaster relocation on **health outcomes**, both physical (e.g., mortality, injury, diseases/infections, medical service use) and mental (e.g., psychological morbidity/ distress, PTSD, depression) but observed paucity of studies and inconsistency in results (Uscher-Pines, 2009). Another possible impact of relocation was observed to be **reduced risk and vulnerability of disaster** (Petz, 2015).

REPORTING AND MONITORING

One of the two reviews on reporting and monitoring interventions focused on remote sensing techniques in monitoring post-fire effects and patterns of forest recovery (Chu & Guo, 2014). The other review was on reporting, instead of monitoring and pertained to reporting pre-hospital major incident medical management. It studied templates for reporting incidents at the stage of response execution (Sabina et al., 2012). Both of the reviews had a clear geographical focus on high income countries.

OUTCOME

Monitoring of post disaster effects and recovery patterns of a natural hazard, such as forest fire, can result in **knowledge outcomes** by contributing to data source to support the monitoring processes. (Chu & Guo, 2014)

Reporting and monitoring in hospital settings, such as templates for reporting pre-hospital major incident medical management, can improve medical management at the time of disasters and result in improved **health outcomes** (Sabina et al., 2012).

OTHERS

Seven other important interventions were reviewed by one SR each. These are behavioural theories and models; crisis management; health systems approach; international humanitarian assistance; insurance; mechanisms and models of coordination; strategies to manage and allocate scarce resources.

Health systems approach: One of the SRs discussed the holistic health systems approach, which can lead to optimised immediate and long term **health outcomes**, as well as **socio-economic outcomes** (by maximizing human and capital investment. However, it did not report on effectiveness due to an absence of literature (Bayntun, 2012).

Insurance: The SR on insurance focused on weather insurance and area yield- based crop insurance. It looked for **socio-economic outcomes** such as (i) increased take-up of crop insurance, (ii) higher productivity of agriculture, (iii) improved household well-being (e.g. education and health) and (iv) increased income levels. However, due to a large evidence gap, this SR did not comment conclusively on effectiveness. (Shawn, 2012)

Mechanisms and models of coordination: One of the reviews provided evidence of effectiveness of coordination between organizations, agencies and bodies providing or financing health services in humanitarian crises, including natural disasters, on **health outcomes** of affected population and access to health services (Akl et al., 2015).

Strategies to manage and allocate scarce resources: The SR reviewing impact of strategies to manage and allocate scarce resources, including health services and facilities on **health outcomes** for affected population (e.g. access to health services, triage etc.) found the evidence base to be lacking (Timbie et al., 2013).