Resilience thinking in health protection

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ABSTRACT

Background In recent years, the term 'resilience' has gained increasing currency in discussions of emergency preparedness. This review identifies key concepts and explores the relevance of resilience for disaster planning and public health protection.

Methods A systematic review of literature on concepts of resilience, with a narrative summary of key relevant concepts for public health.

Results The key concepts identified were community resilience, disaster resilience and social–ecological resilience. Community and disaster resilience describe a community's intrinsic capacity to resist and recover from a disturbance, while the social–ecological interpretation stresses the importance of thresholds in a society's capacity to adapt to crises. Important elements of resilience include communication, learning, adaptation, risk awareness and 'social capital'.

Conclusions These concepts have clear relevance for public health and emergency planning. Resilient communities should be less dependent on external help in times of disaster. Many features of resilience also encompass the wider social and economic determinants of public health. Difficulties remain in defining and measuring resilience in the population health context.

Keywords community, disaster, health protection, planning, resilience

Background and Aim

The word 'resilience' is increasingly being used to describe a quality previously encompassed by terms such as 'preparedness, business continuity or civil protection',[1] exemplified by its use in relation to the evaluation of responses to the attacks on New York and Washington in September 2001 and Hurricane Katrina in the USA,[2,3] as well as a range of international crises from the 2004 Indian Ocean Tsunami, to the ongoing HIV/AIDS epidemic in sub-Saharan Africa.[4,5] Resilience now forms a key element of the United Nations International Strategy for Disaster Reduction (UNISDR).[6] Despite its growing use in increasingly diverse areas, what does 'resilience' actually mean?

Dictionary definitions of the word refer to the innate property of an object or person to bounce back after a disturbance (latin: *resilire*, to 'leap back'). In the disaster-planning context, use of the term carries the same sense, shifting emphasis away from external emergency planning and recovery measures, and towards the intrinsic capacity of individuals, populations and infrastructure to resist and rebound from shocks.

Yet current understandings of 'resilience' derive from a number of additional sources. The term has a technical definition in physics, denoting the amount of energy a material can hold under elastic strain before permanent distortion or failure.[7] Post-war psychologists adopted the word as a convenient metaphor for describing the capacity of individuals to continue functioning in the face of adversity.[8,9] The inspiration for much of this literature can be traced back to the Holocaust, with observations that some concentration camp survivors were much more able to withstand the trauma they experienced than others, and to studies of children who survived dysfunctional family situations.[9–12] While numerous individual protective factors contributing to resilience

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were identified, the importance of a positive overall social context has been repeatedly emphasized in this work,[13,14] allowing the scope of the concept to expand to encompass entire communities and populations.[15,16]

Paralleling this development, an analogous interpretation of resilience has increasingly been applied within the natural sciences. From the 1970s, ecologists have used the term to describe the properties of robustness and adaptability of entire natural systems, later broadened to include the human elements of managed ecosystems (and thus overlapping with notions of resilience from the social sciences).[17,18] In recent years, the term has spread to an array of other disciplines, including urban planning, economics and engineering.[3,19,20]

While a psychologist's understanding of 'resilience' will differ from that of a construction engineer or an ecologist, all of these interpretations are potentially relevant to the protection of public health. This poses a challenge to those working in the specialty, who may come across the term in a number of different settings. Fortunately, in recent years, a number of broad-based, inclusive definitions of resilience have emerged that draw on many of these diverse concepts.[16,21] In this paper, we review these concepts and discuss their utility in the context of community disaster-preparedness and health protection.

Methods

A systematic literature review was carried out between 16th and 24th May 2010 to answer the following question:

What does 'resilience' mean in the context of health protection and disaster planning?

The following databases were searched:

CINAHL
PUBMED
WEB OF SCIENCE
SOCIAL POLICY AND PRACTICE
DESASTRES
GLOBAL HEALTH

Further relevant articles were identified from follow up of cited references. When international governmental and NGO publications referred to resilience, an up-to-date definition was sought from the relevant organization's website.

Search strategy
(i) Initial terms—
    (a) Resilience AND (health protection OR health security OR disaster planning OR disaster preparedness OR emergency planning OR emergency preparedness)
(ii) Inclusion criteria—
    (a) English language
    (b) The article relates to a community or population
    (c) The article offers a definition or description of resilience
(iii) Exclusion criteria—
    (a) Articles concerned primarily with individual psychological or emotional resilience
    (b) Articles that consider natural or physical systems in isolation, with little or no reference to impacts on wider human society.

Results

The initial electronic search produced 296 unique abstracts that were subsequently screened for inclusion criteria (a) and (b). A full text search of the resulting 146 articles identified 54 for inclusion in the review after the remaining criteria were applied. An additional seven articles were identified from the reference lists of included studies; so a total of 61 articles were included in this review.

Resilience concepts identified in the review

The following concepts of resilience were identified repeatedly in the articles reviewed. Table 1 provides representative definitions for these concepts and indicates their relevance to public health.

(i) 'Disaster resilience' describes the capability of a community or society to resist and recover from a disaster.[21]
(ii) 'Community resilience' describes the capability (or process) of a community adapting and functioning in the face of disturbance.[16]
(iii) 'Ecosystem' or 'social–ecological resilience' describes the capacity of natural and social systems to absorb disturbance while remaining within the same functional state.[22]
(iv) 'Infrastructure resilience' describes the capacity of built infrastructure to continue functioning during disasters. This might include roads, buildings and bridges.[23]
(v) 'Individual' or 'psychological resilience' describes the capacity of individuals or groups of people to cope with adversity and continue functioning.[24]

A number of other usages of the term were identified in a smaller number of papers, often applied in narrower contexts:

Table 1 Resilience concepts

Concept	Representative definition	Relevance to public health protection	Study	Total
Community resilience	'… a process linking a set of adaptive capacities to a positive trajectory of functioning and adaptation after a disturbance.' Norris et al.[16]	The overall physical and mental health of a population partly determines its resilience. Many social and economic determinants of health also influence community resilience.	Cabinet Office[1] Chandra et al.[43] Wood and Soulard[36] Plodinec[49] Edwards[50] Mendes and Tavares[33] Leonard et al.[51] Schoch-Spana[39,52] Norris et al.[16] Ebi and Semenza[53] Gilbert[54] Reissman et al.[55] Coles and Buckle[56] Dawes et al.[2] Bruneau et al.[57] Paton et al.[58] Buckle et al.[59]	18
Disaster 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 … [comment] determined by the degree to which the community has the necessary resources and is capable of organizing itself both prior to and during times of need.' UNISDR[6]	Health aspects of emergency planning and disaster management (including emergency medical services, health service business continuity, sanitation).	Stevens et al.[60] Jang and Wang[61] Chhibber and Laajaj[35] Chen et al.[47] Fundter et al.[34] Keim[44] Twigg[40] De Haen and Hemrich[41] O'Brien[62] Sapountzaki[63] UNISDR[6,21]	12
Social–ecological resilience	'Resilience is the capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks.' Walker et al.[22]	The capacity of public health systems to cope with broad societal and environmental changes; links between biodiversity and health, and climate change and health.	Webler[64] Longstaff and Yang[32] Baker and Refsgaard[31] DeFur et al.[38] Wallace et al.[65] Bauer[66] Adger et al.[15] Walker et al.[22]	8

Continued

Table 1 Continued

Concept	Representative definition	Relevance to public health protection	Study	Total
Infrastructure resilience	'Resilience can be achieved by enhancing the ability of a community's infrastructure, e.g. lifelines and structures, to perform during and after a hazard, as well as . . . strategies that enable communities to return to levels of pre-disaster functioning.' McDaniels et al.[11]	Public health aspects of infrastructure design and function: safety legislation, building codes etc.	Bosher et al.[67] McKay[30] Dynes[68] McDaniels et al.[23] Pitt[28]	5
Individual resilience (psychological resilience)	'. . . the processes of, capacity for, or patterns of positive adaptation during or following exposure to adverse experiences that have the potential to disrupt or destroy the successful functioning or development of the person.' Masten et al.[8]	Maintaining community mental health before, during, and after disasters.	Masten and Obradovic[24] Paton et al.[5] Larkin and ld[69] Paton et al.[70]	4
Organizational resilience (3), network resilience (2), urban resilience (1), system resilience or other/unclear (8)		Sustaining hospital and health care system functions during crises, including IT and communication systems; promoting healthy urban environments	Gifun and das[19] Frattini et al.[29] Xie et al.[25] Batniji et al.[37] Corfield[42] Qiao et al.[71] MOD[27] Lambert[72] Campanella[3] Rodriguez and rre[73] Bland[74] Griekspoor et al.[75] Kendra and tendorf[76] Sternberg[77]	14
			Total	61

(i) 'Network resilience' describes fault tolerance in a physical network—such as communications, water or power systems.[25]

(ii) 'Urban resilience' and 'organizational resilience', respectively, describe the capacity of a city/urban area, or of organizations, to resist and recover from disturbances.[3,19]

(iii) Other usages vary according to context; 'engineering resilience' in the ecological literature describes the rapidity of a system's return to equilibrium after a disturbance;[22] a number of articles applied resilience to specific circumstances or settings (flood resilience, healthcare resilience and military resilience)[26−28] and the term system resilience was frequently applied alongside the aforementioned resilience concepts, highlighting the complex, interdependent character of communities and their infrastructure.[23,29,30]

Common elements in descriptions of resilience

There is a striking degree of commonality in the terms used to describe the different concepts of resilience, even across very different disciplines.

The importance of 'communication' was stressed in most articles, whether in the form of physical telecommunication systems, organizational lines of communication between people and agencies involved in disaster recovery, or in the social networks that promote community cohesion.[3,31−33]

'Learning' and 'adaptation' were frequent themes. This 'adaptive capacity' takes many forms, from education on disaster risk in schools,[34] to the flexibility to reprogram computers in a network to rapidly respond to malicious 'denial-of-service' attacks.[25]

Other recurrent elements include public 'risk awareness',[33−36] 'trust' and 'social cohesion' ('social capital');[31,32,37−39] 'good governance';[6,33,36,40] adequate 'planning and preparation';[19,31,33,40,41] 'redundancy' of critical systems;[2,3,15,42] regional 'economic capacity' and 'economic diversification'[3,16,31,35,43] and the state of the 'population's underlying physical and mental health'.[16,31,39,43,44]

Examples of these components of resilience are found in Table 2.

Key concepts

Community and disaster resilience are, in practice, largely synonymous terms. Both are inclusive and holistic concepts, capable of incorporating most other descriptions of resilience identified in the review. The notion of community resilience developed, in part, from the recognition that many of the protective factors that enhance the psychological resilience of key groups of individuals facing adversity, such as vulnerable adolescents, operate at the community level;[13,16,24] yet the concept can be readily extended to include elements from different disciplines concerned with managing crises. These might include the fault tolerance of power, water and communications networks; the survivability of buildings, bridges and other physical infrastructure; organizational preparedness and good governance; and less tangible but important factors such as public trust and social cohesiveness. These components contribute to a desirable (normative) ideal of 'community resilience' to potential disasters.

Social–ecological resilience overlaps with the previous concepts, but places human society firmly in the context of its wider habitat. It reflects the buffering capacity of the physical and natural environment, combined with the adaptive capacity of the people within it. Resilience is the degree to which a social/ecological system can sustain itself in the face of disturbance before crossing a critical threshold, leading to failure and loss of structure and identity.[22] Originally derived from empirical observations and mathematical modelling of natural ecosystems, it conveys the properties of both resistance and adaptation to those external forces acting to change the status quo. It does not include the process of recovery from a disaster, and is neutral in relation to the desirability of a society's current functional state.

These concepts can be applied in many diverse settings. Inclusive notions of resilience provide a framework for crisis planning that includes consideration of the wider physical, psychosocial and economic factors that help populations resist and adapt to both acute dangers—such as disease outbreaks, acts of terrorism, chemical incidents, extreme weather events or natural hazards—and to more gradual 'rising tide' public health threats, such as emerging infectious diseases or climate change.

Discussion

Main finding of this study

Many concepts of resilience share common features, despite their origins in diverse disciplines. Many of the factors contributing to resilience will already be familiar to public health practitioners, as they also contribute to the wider social and economic determinants of health.

What is already known on this topic

There has been some convergence of the range of elements that constitute 'resilience thinking' in recent years,

Table 2 Components of resilience

Component of resilience	Illustrative example	Number of articles
Communication	The United States Coast Guard was perceived to have responded effectively to Hurricane Katrina, in contrast to other US state and federal agencies. This has been attributed, in part, to its attitude towards communication. It made clear its expectations of local commanders prior to the hurricane's arrival. It established multiple communication channels in case of failure of a single system. The pre-existing policy of maintaining links with all levels of government, and encouraging personal contacts with emergency response leaders, allowed it to coordinate effectively with other agencies involved in the response[31]	>25
Learning (education, knowledge)	Widespread knowledge of basic life support (BLS) techniques in the population was cited as one reason why the 1993 California earthquake caused 61 fatalities, compared with the 25 000 fatalities in the 1989 Armenia earthquake, which was the same magnitude[54]	>20
Adaptation	When the municipal water supply failed in the 1994 Los Angeles earthquake, hospital authorities in Northridge maintained essential services by emptying their swimming pool (normally used for patient rehabilitation exercises) and securing access to a nearby brewery's off-grid drinking water supply[23]	>25
Risk awareness	Successive years of floods, landslides and forest fires in central Portugal over the years 2000–07 raised public and government awareness of risks from natural hazards in the area. This prompted a detailed vulnerability analysis of the region, and stimulated a number of community hazard awareness initiatives, such as primary and secondary school Civil Protection Clubs[33]	>10
Social capital (trust, social cohesion)	The delay in US government recovery efforts after Hurricane Katrina and the consequent loss of trust in the authorities, led to a number of 'bottom-up' community initiatives in New Orleans. One notable example is the Common Ground Collective, which started digging out the Lower 9th ward within a week of the immediate disaster ending. It claims to have hosted 10 000 volunteers, and later became involved in representing residents in government hearings and planning decisions[31]	>15
Good governance	Decentralization of emergency planning in the Netherlands has been identified as a positive example of good governance; the establishment of local and regional resilience forums in the UK reflects the same principle of 'subsidiary function' (devolving decision-making to the most local level feasible). Examples of poor governance are more frequent in the literature. A key element of the New Orleans evacuation plan was neglected when public buses were not moved to higher ground before Hurricane Katrina struck[1,31,34]	>5
Planning/preparedness	An assessment of disaster resilience in hillside communities in Taiwan explored correlations between vulnerability to landslides in different regions and the degree of planning and preparedness in the local communities concerned. Measures such as warning systems, relief teams, prepared evacuation routes and regular hazard drills were important components contributing to resilience in potentially vulnerable communities[47]	>25
Redundancy	The September 2001 terrorist attacks in New York demonstrated the importance of redundancy in communication systems. Organizations' planned redundancy based on the use of several different providers proved to be false, as many systems were actually using the same physical infrastructure. When a major telecommunications hub was destroyed, many systems failed—but the internet (a distributed network with built-in redundancies) continued to function[2]	>5
Economic capacity and diversification	Resource-poor rural regions in the Sahel were vulnerable to the effects of the 1972–73 drought, leading to widespread famine. Prior to the drought government policy had an urban bias, and farmers were encouraged to grow cash crops for export rather than food for local consumption. However, agricultural diversification in the region since the 1970s has helped restore its resilience[35]	>10
Population physical and mental health	The situation in the Israeli-occupied Palestinian territories over the period 2000–09 demonstrates the links between population health, poverty, and social cohesion in a community facing sustained disturbances. The effect of the uprising and Israel's 2008 attacks on Gaza was detrimental to the physical and mental health of the population: lack of effective sewage treatment threatened sanitation, hospitals lacked electricity, and security checkpoints limited access to healthcare[37]	>10

increasingly encompassing the importance of engaging with a community's own economic and environmental resources, social cohesion, interconnectedness and adaptability in the face of crisis. The UNISDR definition is noteworthy in capturing concisely most of the elements of resilience described in this review; it shares the inclusive nature of proposed 'community' definitions,[16,43] yet also references the idea of system stability, which is an important feature of social–ecological interpretations.

What this study adds

We propose that inclusive definitions of resilience, such as that used by the UNISDR, have value for emergency planners. While authorities still need to maintain their own readiness and plan for the resources they control, disaster response and recovery should be more effective when communities are resilient and able to contribute more from their internal resources. Conversely, the process of identifying communities that lack resilience should help planners match external resources to the areas of highest need—even if this is an inexact science.

For the communities themselves, promotion of resilience has significant rewards: disaster mitigation and avoidance are hardly the only benefits that follow from a robust and diversified economy, a healthy, well-educated and cohesive population, and a widespread readiness to adapt to the unexpected.

Limitations of this study

One problem that emerges from this review is the difficulty in determining how to evaluate resilience. Developing and then applying a universally agreed definition consistently across populations will be problematic when communities vary so widely in their size, structure and capacities, and in the range of potential health crises they face. These difficulties exist both within and across disciplines: differing approaches to quantifying individual resilience in the field of adolescent psychology point towards significant future challenges in evaluating the multidimensional aspects of resilience at the community and population levels.[45,46] To date, this problem has been addressed by maintaining a narrow focus and considering specific regions facing known threats.[29,47] Although promising qualitative and quantitative methodologies for determining community resilience have emerged,[40,48] their generalizability remains unclear. Without some degree of standardization of methods and outcomes for assessing resilience, it will remain difficult to make meaningful comparisons between diverse communities facing potential crises, and there remains significant scope for further research in this area.

Acknowledgements

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