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Intersectoral approaches: the key to mitigating psychosocial and health consequences of disasters and systemic risks

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Abstract

Purpose – The current pandemic and ongoing climate risks highlight the limited capacity of various systems, including health and social ones, to respond to population-scale and long-term threats. Practices to reduce the impacts on the health and well-being of populations must evolve from a reactive mode to preventive, proactive and concerted actions beginning at individual and community levels. Experiences and lessons learned from the pandemic will help to better prevent and reduce the psychosocial impacts of floods, or other hydroclimatic risks, in a climate change context.

Design/methodology/approach – The present paper first describes the complexity and the challenges associated with climate change and systemic risks. It also presents some systemic frameworks of mental health determinants, and provides an overview of the different types of psychosocial impacts of disasters. Through various Quebec case studies and using lessons learned from past and recent flood-related events, recommendations are made on how to better integrate individual and community factors in disaster response.

Findings – Results highlight the fact that people who have been affected by the events are significantly more likely to have mental health problems than those not exposed to flooding. They further demonstrate the adverse and long-term effects of floods on psychological health, notably stemming from indirect stressors at the community and institutional levels. Different strategies are proposed from individual-centered to systemic approaches, in putting forward the advantages from intersectoral and multirisk researches and interventions.

Originality/value – The establishment of an intersectoral flood network, namely the InterSectoral Flood Network of Québec (RIISQ), is presented as an interesting avenue to foster interdisciplinary collaboration and a systemic view of flood risks. Intersectoral work is proving to be a major issue in the management of systemic risks, and should concern communities, health and mental health professionals, and the various levels of governance. As climate change is called upon to lead to more and more systemic risks, close collaboration between all the areas concerned with the management of the factors of vulnerability and exposure of populations will be necessary to respond effectively to damages and impacts (direct and indirect) linked to new

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meteorological and compound hazards. This means as well to better integrate the communication managers into the risk management team.

Keywords Systemic risks, Intersectoral approaches, Psychosocial impacts, Health consequences, Climate risks, Climate change

Paper type General review

1. Introduction

This past decade was characterized by an unprecedented increase in the number of meteorological and climate disasters, associated with the critical temperature rise driven by the escalating greenhouse gas emissions (GHG) due to human activities (IPCC, 2018, 2019; World Meteorological Organization WMO, 2022). On a global scale, the annual average temperature has already increased by more than 1.2 °C compared to preindustrial levels (i.e. above the 1850–1900 baseline period; World Meteorological Organization WMO, 2022), resulting in profound and rapid deleterious health and human consequences. According to recent assessment reports of the Intergovernmental Panel on Climate Change (IPCC, 2013, 2014, 2018, 2019), climate-related risks will continue to increase with the rate of warming in line with the scenarios of GHG emissions. Those will be higher for global warming of 1.5 °C than at present, but will strongly increase at higher warming thresholds (high confidence; see IPCC, 2018). These risks vary according to geographic location, in line with the amplitude, severity and rapidity of climate changes across continental and oceanic areas, and increase with levels of exposure and vulnerability (high confidence, see IPCC, 2018).

Over the last decades, weather-related events have induced many consequences worldwide, including the displacement of an estimated 23.1 million people on average each year (GIDD, 2020), the acceleration of biodiversity loss (Trisos *et al.*, 2020), the rise of food insecurity and undernutrition for vulnerable populations (Watts *et al.*, 2021), and important damages notably to infrastructures (Wallemacq and House, 2018; UNDRR, 2019). Over the following decades, climate change and its associated environmental risks will further destabilize the foundations of human health and well-being. The Global Risks Report (World Economic Forum, 2020) even considers climate change and extreme events as one of the five most damaging or probable global risks to come (notably through an exponential increase in economic costs).

Over the last year, the ongoing COVID-19 pandemic has exposed the detrimental bearing such global crises can have on health systems and economies worldwide. This threat and other systemic risks occurring in the context of profound and irreversible socioenvironmental changes, with compound effects, emphasize the urgent need for an integrated and intersectoral approach to understanding and addressing risks and impacts of such crises on the most vulnerable populations (United Nations, 2020). Intersectorality is a collaborative approach, which brings researchers and practitioners from disciplinary fields in at least two of the four major sectors (natural sciences and engineering, humanities and social sciences, arts and letters, and health) together on a same research topic, problem, method or question. However, it is more than the simple combination of several disciplines and sectors, as this involves a firm engagement in a joint, cocreated approach, using innovative and integrated methodologies, and a common comprehension and development of research problems (see FRQ, 2021).

This article first defines in Section 2 the concept of systemic risk, presents some socioecological frameworks that can help us understand and act on the multidimensional determinants of psychological health, and provides an overview of the psychosocial impacts associated with disasters. Following the socioecological models and based on case studies from Quebec, Section 3 proposes a better integration of individual and community factors involved in disaster response. The importance of a systemic vision and intersectorality is emphasized. Finally, Section 4 attempts to broaden the vision to more institutional and systemic

considerations and proposes strategies in this sense in order to overcome the current shortcomings in risk management, particularly related to floods. This is done using the Sendai Framework as a reference. Recommendations in light of the scientific literature and experiences in Quebec are also proposed, including the establishment of an intersectoral network on flooding.

2. Context

2.1 Systemic risks

Over the next decades, climate change and its related consequences will generate more and more systemic risks (IPCC, 2019). According to the last Global Assessment Report (GAR) on disaster risk reduction, published by the United Nations Office for Disaster Risk Reduction (UNDRR, 2019), "*a systemic risk emerges when substantive elements of a system contribute to the entire system having a certain risk profile or level*". In the case of ongoing climate change, the risks are quite high, complex and interconnected through various natural and human factors. For instance, hazards caused directly or indirectly by climate change (floods, storms, etc.; see IPCC, 2018 and 2019) lead to the highest consequences on human and economic losses among all natural hazards (WMO, 2021). Furthermore, not only does climate change affect directly and indirectly populations and societies, it also affects resiliency and coping capacities, i.e. the social context, sanitary factors, economic conditions, etc. According to the IPCC (2018), notably, climate risks are the result of dynamic interactions between meteorological hazards and climate extremes, pre-existing local vulnerability and exposure factors, which will notably affect socioeconomic, technological and demographic characteristics of all societies (see IPCC, 2018; UNDRR, 2019). As numerous scientific studies on risks and human security have shown, exposure and sources of vulnerability and resilience moderate the relative severity of climate change impacts (e.g. Berry *et al.*, 2010; IPCC, 2012; Disse *et al.*, 2020). Furthermore, according to these studies and models, the vulnerability factors are found on individual, community and organizational levels (see Figure 1). Among the risk factors, socioeconomic and health determinants play a key role in exacerbating the consequences of a major single event or combined hazards on human

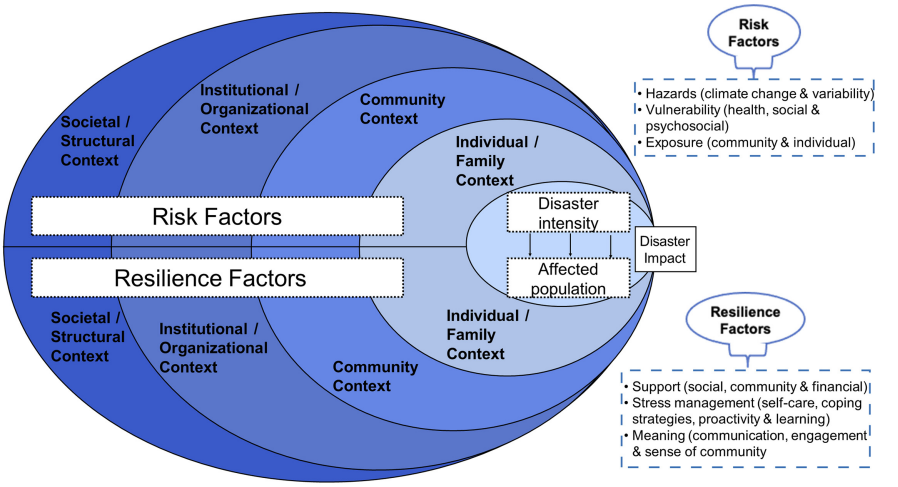

Figure 1.
Disaster socioecological model

Source(s): Adapted from Shultz *et al.* 2017 with a declination of examples of key risk and resilience factors

well-being, in line with the context of vulnerability and exposure, and resilience features at all levels within the society and its constituents. As proposed by Shultz *et al.* (2017), disaster impact and aftermath cascades are inherently affected by both risk and resilience factors, as suggested in Figure 1.

Pre-existing mental or physical illness, lack of coping capacity, poor social network, urban density, socioeconomic status and marginalization are among these (Cutter and Finch, 2008; Haskett *et al.*, 2008; Few, 2007; NCCMH, 2005). Exposure factors refer to one's presence (living area or livelihood) in an area affected by or likely to be affected by a hazard. It also refers to who and what is exposed to a hazard and how sensitive they are to that exposure as climate or disaster risk is not just about the likelihood and severity of the hazard event (IPCC, 2012, 2019; Poljanšek *et al.*, 2017). Since both (vulnerability and exposure) factors change rapidly with the socioeconomic and demographic developments, the socioenvironmental context of any high impact weather or hazard event has to be determined in a proper dynamical way combining various expertise, and scientific and practical knowledge.

Hence, the consequences of climate change follow many pathways depending on the characteristics of the hazard, the region, the communities, the individuals and the underlying societal structure or level of efficiency in current public organizations. They can propagate through natural and human systems in ways difficult to anticipate, with potential domino or cascade effects and potential damaging tipping points. These last can occur within both the physical Earth system (e.g. Greenland ice sheet disintegration, vector-borne and infectious diseases, biosphere boundaries, etc.; IPCC, 2018; Lenton *et al.*, 2019) and the human one (e.g. food and water insecurity, climate migration, infrastructure and social failures, etc.; see Watts *et al.*, 2021). Physical as well as psychosocial consequences for the victims of such compound threats are serious reasons for concern, especially since climate change risks will strongly increase as temperatures continue rising, and will reveal a clear limit to current adaptation options (O'Neill *et al.*, 2017). Bearing in mind the intricate ways climate change will affect our societies, and especially the more vulnerable populations, climate risks are considered systemic, a conclusion rendered increasingly evident through the observed recent natural and anthropogenic disasters' impacts (World Meteorological Organization WMO, 2021; IPCC, 2018, 2019).

2.2 A systemic framework to better understand disaster-related mental health

As outlined above, systemic risks are associated with a myriad of factors influencing the health and well-being of individuals and communities. Socioecological and systemic frameworks can help better understand the complex intertwining of these factors among the interpersonal, organizational, community and social systems [1]. They are also useful in guiding interventions and informing future planning and preparedness efforts.

Socioecological models consist of a nested arrangement of successive structural levels of increasing organizational complexity. They emphasize the dynamic, systemic and mutual interconnectedness of the various layers, and allow the integration of multiple causal processes. This type of model has been used to better understand the multiple determinants of physical and mental health (e.g. McLeroy *et al.*, 1988). For instance, the proposed model by the Canadian mental health association (CMHA, 2021) differentiates four types of mental health determinants:

(1) *Individual characteristics*: biological or genetic factors, personal attitudes and competency, habits and socioeconomic characteristics;

(2) *Community*: Living environment such as family, school, work, housing and neighborhood;

(3) *Systems, institutions and regulations*: Education and childhood care systems, health and social services system, land use planning, employment support and social solidarity, other systems and programs;

(4) *Global context*: Political and legislative context, economic and demographic context, social and cultural context, scientific and technological context, natural environment and ecosystems.

Other systemic frameworks focus on mental health and climate change-related disasters. For example as illustrated in Figure 2, Berry *et al.* (2010) proposed a causal pathways framework in which climate-related disasters affect community well-being and physical and mental health. This framework, which was here adapted to include ecoanxiety, specifies that impacts on mental health at the individual level result directly from exposure to weather events, and indirectly from contextual, environmental, economic and social factors (see Figure 2). From this perspective, communities, organizations and higher policy makers through law and economic measures, can create the physical and social infrastructure that will help citizens and the population build resilience and be less susceptible to negative impacts (for a more detailed model, see Berry *et al.*, 2018; Vergunst and Berry, 2021).

Other models are rather specific to a phase of risk management. For instance, Abramson *et al.* (2010) offer a socioecological framework focusing on postdisaster recovery. In doing so, they aimed to « *develop an operational measure of individual recovery that incorporates mental health, housing, economic and social domains and to assess how mediators and moderators influence recovery* ». Efforts have also been made to schematize models focusing on different phases in an integrated ecological model, i.e. incorporating planning, preparedness, response and recovery elements, suggesting that « *disaster management must occur at various organizational levels that are mutually interdependent* » (Beaton *et al.*, 2008).

Many other socioecological and systemic models exist. The general assumption underlying these models is that the study of climate change and disaster impacts on mental health and well-being, and the strategies to be implemented, must encompass many

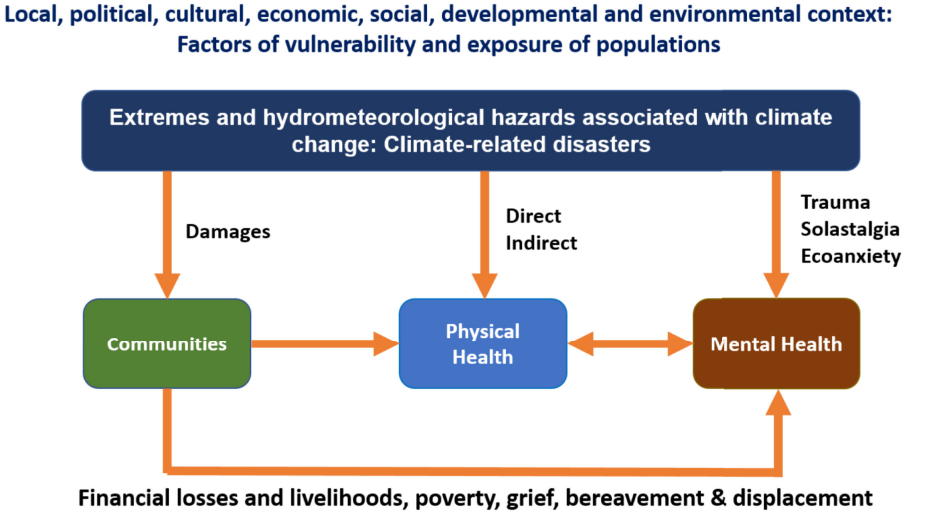

Figure 2.
Framework showing putative causal pathways linking climate change and mental health

Source(s): This model is adapted with permission from Berry *et al.* (2010), and inspired by the work of the Council of Canadian Academies (CCA, 2019)

levels of analysis. For instance, when effects on mental health are widely felt at the individual level on a population scale, it is necessary to question the upstream "safety net", which includes reduction of exposure and reduction of vulnerabilities at all levels. Berry *et al.* (2018) even state that « *mental health could be a lead indicator for measuring progress on mitigating the human impacts of climate change* ».

2.3 Psychosocial impacts and resilience

While impacts and risks of climate change on the environment and our physical health are abundantly covered and documented, psychosocial impacts and risks remain comparatively marginal in the scientific literature, as well as in health and risk communications (see Bisson *et al.*, 2010). Yet, these impacts encompass a wide range of influences that can affect one's psychological state and social environment with potentially detrimental consequences on health and behaviors (Clayton *et al.*, 2014, 2017; Hayes *et al.*, 2019; Hayes and Poland, 2018; Long and Cumming, 2013; Manning and Clayton, 2018; Suzuki and Takei, 2013). The mental health impacts of climate change and weather-related events include post-traumatic stress disorder (PTSD), depression, anxiety, loss of personal and occupational identity, substance abuse and feelings of helplessness and fear. Other such impacts at the community level may include crime, conflict, civil unrest, changes in social ways of life, social dysfunction and loss of safety. Based on past research, Table 1 summarizes various types of main psychosocial and social impacts from various disasters and risks studies (e.g. Brewin *et al.*, 2000; Ozer *et al.*, 2003; NCCMH, 2005; Bouchard-Bastien *et al.*, 2013; Bouchard-Bastien *et al.*, 2016; Clayton *et al.*, 2017; Hayes *et al.*, 2019; de Oliveira *et al.*, 2013).

These impacts on psychological and community health and well-being can be *acute* (direct), *chronic* or *indirect* (Doherty and Clayton, 2011). The acute impacts of climate change are a direct result of disasters or extreme weather (punctual) events such as floods, storms, wildfires, droughts and heatwaves. Chronic impacts result from gradual and longer-term changes in climate like rising sea levels and weather patterns, as well as compound hazards. Indirect effects of climate change and disaster are experienced through a cascade of changes at the social and community levels (e.g. food and water insecurity, delays in cleaning or reconstructions, low social support and financial difficulties, weakened infrastructures or disruptions in communication services). In addition, other indirect (vicarious) impacts on psychological well-being can be caused by the simple observation of climate change impacts, through media coverage, for instance (see Reser and Swim, 2011). Ecoanxiety is a great example of such impacts. They can notably arise when there is a high level of uncertainty (perceived or real), concerning, for instance, the severity, the scale and the timing of current and future risks (Swim *et al.*, 2009).

In the context of a prolonged crisis, the exposure to a variety of stressors can extent or be exacerbated over many months, potentially leading to greater psychosocial impacts. Acute impacts can thus become chronic as the recovery period drags on and the return to normalcy is delayed (e.g. Hobfoll *et al.*, 2007). Chronic distress and prolonged high levels of stress can exacerbate existing physical illnesses or provoke new physical health effects such as sleep disorders and low immune system (e.g. Alderman *et al.*, 2012; Han *et al.*, 2012), leading people in a downward spiral which leaves them even more vulnerable. During this period, multilevel and indirect stressors can indeed lead individuals, through a cascade of changes in the community, social, political or economic context, to experience severe consequences. These secondary stressors increase the burden of a disaster, generating long-term effects and hindering recovery if not effectively addressed through appropriate postdisaster interventions (Lock *et al.*, 2012). As they accumulate, they can put a strain on household dynamics and social relationships, possibly leading to aggression, child and spouse abuse, domestic and social violence, isolation and loss of community bond (see Table 1).

Categories	Psychosocial impacts
Clinical diagnostics	- Anxiety disorders (e.g. dissociative disorder, acute stress disorder, post-traumatic stress disorder, and panic disorder)
	- Mood disorders (e.g. depressive disorder and dysthymia)
	- Neurodevelopmental disorders
	- Personality disorders
Affective symptoms	- Anger
	- Disgust
	- Fear
	- Happiness or sadness
	- Surprise
	- Posttraumatic growth
	- Hope
Cognitive symptoms	- Anguish
	- Delusional thoughts
	- Difficulty concentrating
	- Identity crisis
	- Sense of loss
	- Suicidal ideas
Behavioral symptoms	- Aggressive behavior
	- Deficient personal hygiene
	- Psychomotor agitation
	- Psychomotor retardation
	- Sleeping disorder (insomnia, hypersomnia)
	- Substance use
Categories	**Social impacts**
Sociopolitical dynamics	- Citizen gathering
	- Conflict due to poor management
	- Armed conflicts
	- Increased need for health services
Public order	- Crime
	- Juvenile delinquency
	- Violence
	- Civil unrest
Household dynamics	- Violence
	- Spouse and child abuse
	- Divorce
	- Personal and family disorder
Culture	- Changes in lifestyle
	- Changes in cultural identity
Social ties	- Social discrimination
	- Isolation or lack of connectedness
	- Dehumanization
	- Social dysfunction
	- Loss of sense of safety
	- Sense of self- and community-efficacy
Socioeconomic	- Poverty
	- Food insecurity

Table 1.
Categorization of psychosocial and social impacts based on various disasters and risks studies

The 1996 Saguenay flood that occurred in the province of Quebec in Canada is a good example of these compound or prolonged effects. During this disaster, 16,000 people living near rivers and currents had to be evacuated. Different studies documented the medium and

long-term effects (negative and positive) of this flood event on mental and physical health. Those have included the daily lives of victims of different age groups, taking into account a number of vulnerability and protection factors (e.g. Maltais *et al.*, 2000, 2001, 2002, 2003, 2005b; Robichaud *et al.*, 2001). Among other things, results of these studies revealed that:

(1) Beyond mental health impacts, floods have repercussions in several spheres of the life of affected individuals (family, marital, professional, environmental and political);

(2) The post-flood impacts have an influence on the meaning that subjects give to events and how they deal with them (Robichaud *et al.*, 2001);

(3) Having to leave a residence is stressful and sometimes complicated, and these difficulties are added to other difficulties related to the complicated procedures involved in applying for financial compensation, accumulating worries, sleeping difficulties, being forbidden to return home, fear of theft and vandalism, and fear of being flooded again (Maltais, 2003; Maltais *et al.*, 2002).

More recently, intersectoral studies involving researchers from different backgrounds (medicine, social and natural sciences; see Généreux *et al.* (2020c)) have been conducted in order to measure the impact on the physical and psychological health of individuals, who have suffered from the recent spring floods (2017 and 2019) which occurred along the Ottawa river and around Montreal areas in Québec. Among such studies, over half of the participants directly affected by the floods showed indications for probable mental health disorders, including moderate to severe symptoms of PTSD, anxiety disorder or mood disorder. More specifically, 44.1% of flood victims reported suffering from PTSD symptoms, 21% reported suffering from anxiety disorders and 20% from mood disorders (Généreux *et al.*, 2020c). Level of exposure to flooding, height of rising water in the home and quantity of material loss were the primary stressors most associated with poorer mental health perception, and probable mental health issues among participants. Secondary stressors were also found to affect the mental health outcomes of flood victims in the months following the events. Some of these include insufficient moral, social and financial support, insurance coverage issues and unusable living areas (Généreux *et al.*, 2020c).

All these studies were also important to better understand the domino or cascade effects of repeated or cumulated hazards since they also looked at the impacts of the 2019 floods which affected some of the same victims as the spring floods that happened two years prior. Worst even, some citizens of the flooded areas in Gatineau, a region in the province of Quebec, also experienced a tornado in 2018. One study shows that the affected populations had not yet recovered when the 2019 floods hit (Généreux *et al.*, 2020c). Many residents had not yet recovered from the previous events when the 2019 floods, potentially increasing the stressors they were required to face. Consequently, this has strongly affected the recovery phase, and delayed the return to predisaster stress level and psychosocial normalcy.

This accumulation of risks and impacts is a new reality brought about by climate change, which forces researchers and practitioners to question previous models of risk and stress reactions of survivors. What was taken for granted is no longer valid. As shown in Figure 3, the well-known curve of communities' and individuals' reactions to disasters (e.g. Young *et al.*, 1998; Math *et al.*, 2015) could indeed be questioned as the disillusionment and restoration phases may be interrupted by the occurrence of another disaster or shock in the context of climate change. In this situation, biopsychological response to disaster would be impaired by the second shock or disaster (see Figure 3). Noteworthy, in Quebec, spring flood events can last up to 60 days (e.g. the last 2019 flood event in Québec within the Ottawa watershed) and this long duration could potentially affect initial optimism (heroic and honeymoon phases; see Raphael, 1986) and lead to discouragement and exhaustion, which delays recovery. Future

research should examine the stress response phases in such case. Rethinking these models in a multirisk context is not only essential to better understand stress responses and the resulting mental health impacts, but also to tailor decision-making and intervention strategies to reflect them (especially the rehabilitation and rebuilding phases; see Rao, 2006).

Furthermore, in addition to the negative impacts they generate, disaster events can also contribute to building individual and community resilience. For example, people can experience posttraumatic growth in face of adversity, a feeling they gained something positive such as stronger social relationships, meaning in life and a profound desire to adopt a more sustainable lifestyle (e.g. Lowe *et al.*, 2013; Ramsay and Manderson, 2011; Sattler and Smith, 2020). In order to foster resilience, Pfefferbaum *et al.* (2012) suggest that it is essential to integrate behavioral and mental health management into disaster preparedness and response at different levels of governance, and to include it in education models accessible to all. As will be explained in the following, this needed broader perspective can be facilitated by intersectoral or transdisciplinary approaches.

3. Toward a better integration of individual and community factors in disaster response: Quebec's case studies

The psychosocial impacts of climate change have yet to be systematically addressed and fully integrated in disaster preparedness, response and recovery. Even though the detrimental and possible long-term consequences in the psychological, occupational and social domains are well known (e.g. Berry *et al.*, 2018; Pfefferbaum *et al.*, 2012), more systematic work is needed to incorporate crucial elements into delineating the climate-change–mental-health system. Disaster management must take into account the characteristics of the event, and the characteristics of the affected population and requires the identification of inputs and outputs related to the adaptation activities put in place by stakeholders, including social workers (Rosen *et al.*, 2010).

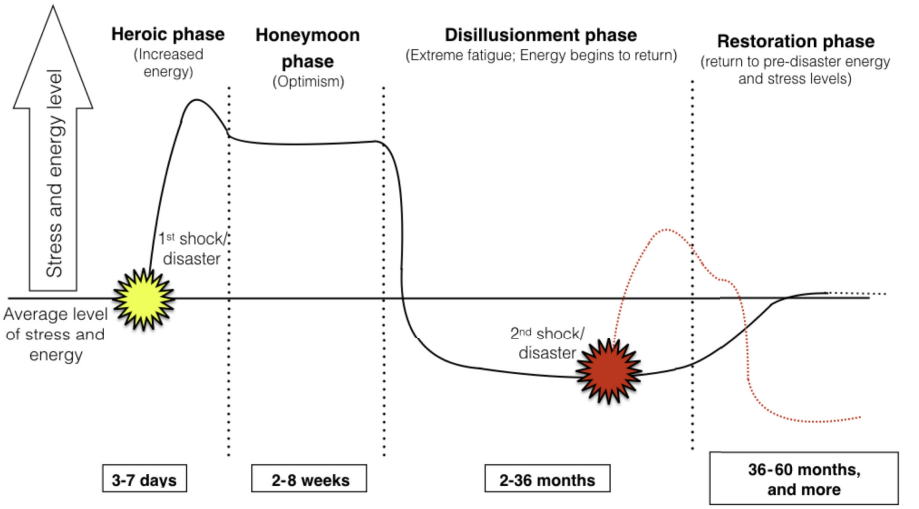

Figure 3.
Biopsychological response to disaster in a multihazard context

Source(s): This Figure is adapted from Young *et al.* (1998), and Math *et al.* (2015). The division into four distinct phases is also inspired by the coping model proposed by Raphael (1986)

It thus makes it « *critical to integrate mental and behavioral health considerations into all aspects of public health and medical disaster management* » (Pfefferbaum *et al.*, 2012). Insights from research on risk and resilience in the aftermath of floods in the province of Quebec highlight best practices and some gaps, and, in doing so, illustrate the added value of an integrated framework for risk management and postdisaster recovery.

3.1 Lessons learned from flood events in Quebec

A major flood event happened in 1996 in Saguenay, Quebec. Two, three and eight years after this event, several quantitative, qualitative and mixed research studies were conducted by researchers from various disciplines (social work, psychology and medicine). Among key results, it was possible to identify and better understand the feelings experienced by disaster victims during and after their exposure to floods, their reluctance to ask for help, and the various secondary stressors they were confronted with as a result of their exposure to floods. The individual, marital, familial, social and professional consequences from this type of hazard were also identified (Maltais *et al.*, 2001; Robichaud *et al.*, 2001). These results and feedback on lessons learned and good practices from municipalities and their institutional and community partners following major disasters showed the importance of implementing various interventions during the 2017 and 2019 floods that would follow. Among them, practices have been applied that consider the realities of populations and the impacts that secondary stressors have on individuals' health and social functioning in the short, medium and long terms. The lessons learned also enabled health professionals, social workers and policy makers to better understand the needs of populations and to better prepare for future flooding events. When important floods occurred again in Quebec in 2017 and 2019, armed with the lessons learned from the Saguenay disaster, a canvassing approach was favored in the aftermath of the event (see Généreux *et al.*, 2020c). This required workers to be creative in reaching out to people to offer support, rather than waiting for people to present themselves to responders. This approach made it possible to tailor approaches to individual needs, to help more people, to intervene quickly, to prevent certain situations from getting out of hand and to overcome the reluctance of some people, especially men, to ask for help. In addition, one-stop shops or recovery support offices were also set up in certain municipalities, in order to help disaster victims in their various administrative procedures. This initiative stemmed from barriers that disaster victims were facing in their recovery process: the various administrative procedures that disaster victims had to complete as well as the delays in responding to compensation requests had been identified as two of the main secondary stressors experienced by disaster victims in previous research (Robichaud *et al.*, 2001; Maltais *et al.*, 2005a, b). By doing so, levels of stress experienced by the victims were significantly reduced, as well as the waiting time to receive answers from both municipal and government authorities regarding the work to be done to return to one's home and the amounts that are granted for this work.

Additionally, with regard to psychosocial interventions that would have been beneficial to the victims, there are, among other things, preventive visits by a front-line worker (firefighter or police officer) accompanied by a social worker during the planning phase (i.e. for social support) in the homes or frequently visited places of flood victims (Généreux *et al.*, 2020c; Maltais *et al.*, 2022). In order to enable disaster recovery, practitioners should assess community needs early and often; to provide services accessible to the greatest number; work collaboratively and proactively (Norris and Alegria, 2005).

Furthermore, during the recovery phase, maintaining a team of psychosocial workers dedicated to floods is essential. Importantly, these studies have also identified some shortcomings in the recovery process. For instance, the Quebec government and its public institutions were found to have difficulty recognizing that the recovery phase can take

anywhere from a few months to several years, depending on the severity of the losses incurred, the resources of the communities and the delays in receiving responses regarding the financial assistance that will be granted to disaster victims. As a consequence, the early withdrawal of psychosocial workers from the field, and the early announcement of the end of the mandates of disaster recovery teams are often observed.

Finally, as experienced in the recent study of Généreux *et al.* (2020b, c), combining health sciences with both social and natural ones has allowed to better identify the role of exposure, both qualitatively (e.g. experience during the floods, support received to deal with them, and self-reported physical health) and quantitatively (e.g. the level of water inside and outside the homes of affected people), on psychosocial consequences, as well as acute (direct) and chronic (indirect) ones after the flood event. This collaboration between various disciplines allows for integration of different perspectives and methodologies and for identification of effective and tailored interventions (Généreux *et al.*, 2020a).

3.2 Lessons learned from multiple and combined hazards

The previously mentioned flood events share many similar features with other disasters that have affected the Canadian population in recent years such as the 2013 Lac Mégantic train derailment, the 2016 Fort McMurray wildfires, the 2018 tornado in Gatineau and the ongoing pandemic. Indeed, they all have unpredictable sudden onsets, caused fear and uncertainty in the population, resulted in great losses, involved home displacements or confinements and required complex government responses. Profound and extensive psychosocial effects and mental health disorders were also documented following all these events (Agyapong *et al.*, 2018; Généreux *et al.*, 2020c). Due to their many similarities, lessons learned during the response to these crises must be applied to the research and/or management of future disasters such as the flooding events and vice-versa.

4. Discussion: from individual-centered to systemic and intersectoral approaches

Prevention, promotion of well-being, reduction of the psychosocial risks of disasters and stressors and recovery must go beyond interventions in fields related to mental health and human relation. They should instead rely on intersectoral approaches, drawing on various fields, including the social, humanities, natural and technology sciences. These approaches to prevent mental health impacts and ensure the maintenance of social cohesion should include a collaboration amongst front-line mental health workers, faith-based and spiritual workers, emergency preparedness professionals, governments (at all levels), public health authorities, environmental and health NGOs (Nongovernmental Organizations), and climate and meteorological services (Généreux *et al.*, 2020b; Hayes *et al.*, 2019; Laurendeau *et al.*, 2007). As the COVID-19 crisis made clear: interdependencies and interconnections exist among systems and fields, which can be sources of vulnerability if they are not adequately managed (United Nations, 2020).

This section attempts to broaden the spectrum of strategies to be implemented by taking a more systemic view of prevention or reduction of psychosocial impacts of flood in a climate change context, in complement to individual and community approaches shown in the previous section. This reflection on systemic risk and the psychosocial impacts of disasters is articulated here around the four priorities of the Sendai Framework (United Nations Office for Disaster Risk Reduction UNDRR, 2015): (1) understanding disaster risk, (2) strengthening the governance of disaster risk to better manage them, (3) investing in disaster risk reduction for resilience and (4) strengthening disaster preparedness to respond effectively, which correspond to the rehabilitation and reconstruction phases. In the following, the subsections are organized accordingly. The last subsection presents the main outcomes

and added values of intersectoral networks, before to propose key recommendations for building resilience in section 5 from Quebec's past and ongoing studies (shown in sections 2 and 3), in line with other national and international researches on risk management and psychosocial risk reduction.

4.1 Understanding and communicating systemic risks to reduce psychosocial impacts

Risk arises from uncertainty, and that risk is about the impact that uncertain events or circumstances could have on the achievement of goals of individuals and communities (Hillson and Simon, 2012). Thus, risk is a social construct (Stewart, 2007). A common and shared understanding of issues related to risks is a condition for the mobilization of the actors involved in its management. Common understanding means pooling communications. As long as the information disseminated, received and understood by the different actors is identical, it becomes possible to prepare a collective, coordinated and effective response to the threats, risks and disasters we are facing. Moreover, communities that repeatedly face hazards learn to better cope with them because they have a clear, common and shared understanding of them (Yates *et al.*, 2016; Leclerc *et al.*, 2020). Flood risks to which a community is exposed are always multifactorial and depend on a combination of meteorological, hydrological, geomorphological, urban, economic and social sources. It is practically impossible to identify a deterministic relationship between a cause and an effect, which poses major challenges in the governance of this type of risk, and especially in terms of communication, because the same issue, such as climate change, can have several different but interrelated effects each requiring specific and adapted care (Schweizer and Renn, 2019). Each of these sources is analyzed by distinct professionals and organizations, such as scientists, government officials, politicians, administrators, contractors, developers, etc. Each has therefore divergent interests, different messages and variable methods to communicate relating to hazards and risks. This confusion in the understanding of risks and especially of ways to deal with them has been observed in Quebec, even in places recurrently touched by floods, leading to conflicts between populations, municipalities and other stakeholders (Leclerc *et al.*, 2020). Those are associated with dissatisfaction, demobilization and distress.

Coordination of messages and communication campaigns is probably as fundamental to an orderly response as the coordination of prevention, mitigation and response actions. The integration of the main players in a single cockpit for communication activities becomes a necessary condition for adaptation to new risks.

Therefore, to help the decision-making process, Malavieille *et al.* (1995) reveal as essential the necessity to divide the problematic posed into several coherent subparts, via an analysis of the situation presented, and then to be able to compose a global action made up of various coherent actions carefully arranged with each other. It is the combination of these parts that will ultimately make it possible to modify the development of the claim. Those interdependences between numerous factors and signals are a source of strength and efficiency when you need to manage a system. We need to understand the resilience for interdependence among systems to manage the risk adequately (United Nations, 2020).

4.2 Manage general or multiple disasters and psychosocial risk

To move from a reactive to a preventive and proactive view of managing people-related risks in the context of climate change, systems, such as health and social services, must take a systemic approach to resilience. Although adjustments were made along the way, as the examples of the 1996 and 2017–2019 floods in Quebec show, their lack of preparedness is still being criticized. Several failures in the early stages of the COVID-19 pandemic were observed in the province that experienced the worst death toll in the country in the first wave, followed by a huge epidemic of social and mental health problems. This pandemic and the recurrence

and increased intensity of extreme weather events under climate change, calls for a review of the current risk governance models that need to be continuously and sustainably monitored.

"A climate resilient health system is one that is capable *to anticipate, respond to, cope with, recover from and adapt to* climate-related shocks and stress, so as to bring sustained improvements in population health, despite an unstable climate" (WHO, 2015, p. 8).

To make it possible, it is imperative that guidelines for the management of mental and behavioral health are integrated into the guidelines for disaster management, by the appropriate levels of governance. It is also necessary to maintain an education that promotes the right actions to be adopted in the event of an emergency or disaster, so that individuals and communities are adequately equipped to prevent the development of mental disorders during and after a disaster (Pfefferbaum *et al.*, 2012). Vernberg *et al.* (2008) add that information on adaptive and maladaptive coping needs to be taught to disaster victims, as well as brief stress-relief techniques that can be used in acute post-disaster situations. An important part of psychosocial disaster management is to ensure that it includes information on anger management and dealing with negative emotions.

The World Health Organization (WHO, 2015) suggests acting simultaneously on several interrelated components of health systems such as governance, health workforce, integrated risk surveillance and early warning systems, research on health and climate, health programs addressing climate-related health risks, emergency preparedness and management as well as financing. All these suggestions or recommendations make sense in the strengthening of disaster risk governance if a coherent integration and intersectoral cooperation are real and clearly effective at all levels (organization, community and individual).

One of the priorities to be pursued in integrating mental and behavioral health in terms of preparedness, response and resilience to disasters seems to be the need to develop a clear and directive system of governance aimed at establishing the precise role of psychological impacts and behavioral as part of a unified public health (Pfefferbaum *et al.*, 2012). All in all, the issue in this context is that individual capacity to follow health-related advice is strongly linked to the ability to decode complexity, allowing possible consequences of decisions taken in a systemic approach. By understanding the system, it becomes easier to align the needs of the emerging field of intersectorality in crisis management (Berry *et al.*, 2018).

4.3 Investing in psychosocial risk reduction

As shown in section 2, mental health problems can exacerbate problems that already existed before the disaster, thus generating greater individual, community and also societal problems and increased costs. In terms of disaster preparedness, response and recovery, the importance of behavioral and mental health should not be overlooked. Indeed, it is an important part of general health that can lead to improve the resilience of communities, and also strengthen and maintain the response of health systems (Pfefferbaum *et al.*, 2012).

However, the fields of prevention, human relations and mental health have long suffered from chronic underfunding in Quebec and elsewhere (Bélanger *et al.*, 2019). As mentioned earlier, psychosocial impacts are the tip of the iceberg and their reduction requires an upstream mobilization as well as an interdisciplinary, intersectoral and systemic vision of risks. However, sustained investment is needed to ensure that intersectoral approaches go beyond the anecdotal and becomes the norm. The mental health commission of Canada (2017) estimates costs of mental health problems at $50 billion per year in 2016 ($1,400 per Canadian annually) from services, productivity loss and quality-of-life value. Investments to prevent those problems can therefore pay off and mental health as to be seen as a wealth to protect. In fact, reduction of psychosocial risk and development of individual and collective resilience need to be supported by sufficient and stable investment.

Furthermore, too often, once the crisis is over, little effort is made within the public authorities to reduce three predominant risk factors present among vulnerable populations: (1) the degree of exposure to recurrent flooding, (2) the lack of individual or environmental resources to cope with it and (3) the probability of experiencing negative consequences following exposure to flooding. Thus, despite the advances that have been made regarding the consequences of flooding and the good practices to be prioritized during and after the event, much effort still needs to be made before the event to prevent the recurrence of flooding, and its adverse consequences at the community and individual levels.

4.4 Enhancing disaster preparedness for effective response, and to "build back better" in recovery and rehabilitation

Support for populations at risk of experiencing psychological impacts depends on local health and social services teams, which may not be sufficient for the task (Brisson and Lessard, 2021), as while for social impacts, no one seems specifically designated to address them in the long term (Marchand *et al.*, 2014). The recovery phase, especially for psychosocial rehabilitation, may extend into the weeks, months or years following exposure to a disaster (Ehrenreich, 2001; Maltais *et al.*, 2005a, b; Laurendeau *et al.*, 2007; Amaratunga and O'Sullivan, 2006). Quebec generally does well in terms of disaster preparedness and response, but preventive and recovery approaches are more deficient (Généreux *et al.*, 2020c; Laurendeau *et al.*, 2007; Malenfant, 2013; Maltais, 2015; Leclerc *et al.*, 2020; Brisson and Lessard, 2021). Support for populations at risk of experiencing psychological impacts then depends on local health and social services teams, which may not be sufficient for the task (Brisson and Lessard, 2021), as while for social impacts, no one seems specifically designated to address them in the long term (Marchand *et al.*, 2014).

It is no longer possible to act in silos or in a reactive manner in a context of multiple risks and overlapping recovery phases. Psychosocial care is not a one-off intervention, but is part of an ongoing process. In the initial stages of a disaster, it is primarily social in nature and must be tailored to the needs of the affected community. As the needs of mental health are greater for exposed people than none exposed ones (Généreux *et al.*, 2020c), this requires oriented professional services (Rao, 2006) from both social and health expertise.

Actions must be anchored in the empowerment and capacities of individuals and communities. They must also be effective, collaborative and integrated across different levels of services, from the individual to specialized services. To do this, it is essential to develop common tools and language as the example presented in Figure 4 which was created to support an intersectoral toolkit to prevent and reduce psychosocial impacts of extreme weather events in the context of climate change (Lessard *et al.*, 2020). The most promising interventions from literature and validated with 32 experts from different fields of expertise (health, social sciences, municipalities, water sciences, emergency measures experts, etc.) were classified for preparation, intervention and recovery phases and for three levels of interventions (individual/community, front line services and specialized mental health services), according to stepwise care model. The stepwise care model argues that the majority of people will benefit from low-intensity approaches and interventions that they can implement themselves or find with their loved ones or in their community (Clayton *et al.*, 2017; McDermott and Cobham, 2014) while others will require services from the formal health system (primary health and social care or specialized services). Figure 4 also supports that we have to take advantage of learnings in the intervention and recovery phases to improve our preparedness. Finally, it underlines the need for prevention and mental health promotion actions to be ongoing, and not only in a postdisaster context, much like a safety net supporting individual and collective resiliencies at all times.

4.5 An intersectoral network

The recent establishment (in 2019) and development of the InterSectoral Flood Network of Québec (RIISQ) aims to contribute to the needed effort towards intersectoral collaboration between universities and various socioeconomic partners and between disciplines. The RIISQ has been created after recurrent major floods over the last decades occurred in various areas in Québec. Despite years of active research and efforts in the field of flood protection, research has remained restricted to disciplinary silos, and as a result, failed to provide integrated solutions to the complex issue of flooding.

In recent years, intersectoral has been mishandled in Québec by the centralizing aims of certain public policies, which have undermined regional and local instances of cooperation, leading to the erosion of intersectoral links that had been established over time (Richard *et al.*, 2021; Brisson and Lessard, 2021). Networks such as the RIISQ or the new Québec network COVID-Pandemic Network (QCPN), both funded by the Fonds de recherche du Québec (FRQ), could become influential forums for sharing knowledge, building intersectoral action aimed

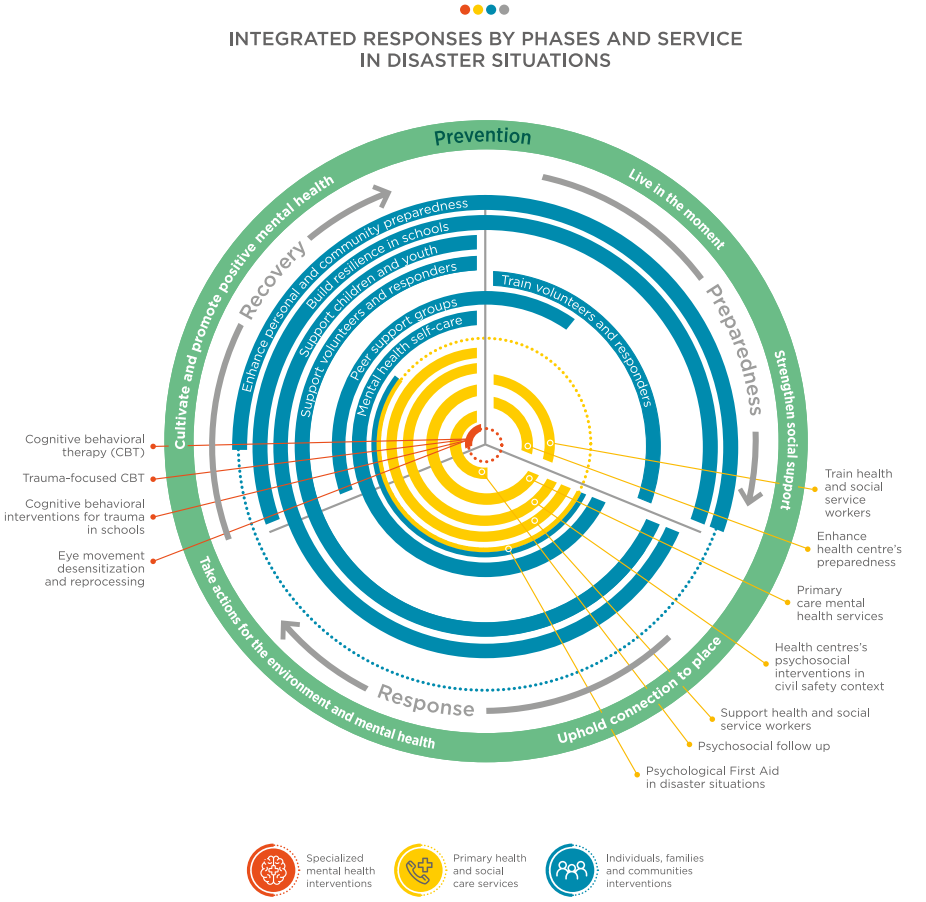

Figure 4.
Integrated responses by phases and services level in disaster situations

Source(s): Lessard *et al.* (2020)

to reduce systemic risk and increase the resilience and adaptation of environments and populations.

In doing so, intersectoral expertise and collaboration between various members of the RIISQ have allowed the integration of different perspectives and methodologies and the identification of effective and tailored interventions (Généreux *et al.*, 2020a). This strength has been a corner stone of many disaster related studies, including the ones previously mentioned on the impacts of flood events. Intersectorality was notably essential in a study aiming to document the state of health and the vulnerability in relation with the Quebec spring floods of 2019. The strength of this project lied in the combination of knowledge and expertise from three Quebec universities (relying on experts in the fields of hydrometeorological hazards, disaster risk reduction, mental health and psychosocial interventions), three regional public health authorities directly affected by the 2019 spring floods, the Institut national de santé publique du Québec (INSPQ) and various groups of interest (health and social services network, civil security, the municipal sector, the Red Cross, etc.). The use of a participatory approach through a monitoring committee made up of key local stakeholders (from multiple sectors such as municipalities, public safety, nongovernmental organizations and social services) was also considered a strong point for this project as it facilitated community engagement and intersectorality.

In facilitating intersectorality, the RIISQ network contributes in a concrete way to a better understanding and to the reduction of risks and impacts. It does it by bringing together different researchers and field actors for whom it would otherwise be difficult to meet, so they can discuss and reflect together on common issues. It does also it by facilitating co-training between network members via webinars, panels and workshops that promote a systemic and intersectoral vision of research issues and practices, and by funding, through calls for proposals and student grants, innovative and cross-sectoral projects. It also contributes to research in an innovative way by creating intersectoral research partnerships (through joint grant applications), leading to richer results and a refined understanding of the issues at hand. But, the use of intersectoral approaches is not limited to the construction of the research project, as they are also applied to the knowledge transfer stemming from the results. This allows for a more adapted and coherent use of the research results by various partners (public and community), with direct impact to the services offered in the medium and long terms for disaster victims, and for all communities that may be affected by future floods (e.g. Généreux *et al.*, 2020c). The ongoing co-construction by various partners and several academic institutions of a platform for open data and knowledge sharing on floods, on the one hand, and popularized content, on the other hand, also contribute to raising awareness, education and coping capacity.

5. Building resilience and key recommendations

Based on a socioecological view, and in line with the UNDRR (UNDRR, 2019) and with the United Nations research roadmap for the COVID-19 recovery (United Nations, 2020), it is now crucial to build community resilience into interconnected systems that maintain and reinforce the social protection and basic services, including the health and the psychosocial well-being of individuals, communities and organizations. Table 2 presents a synthesis of suggested recommendations arising from what we have presented throughout this article, utilizing expertise from social and human sciences, as well as health, communication (Motulsky *et al.*, 2017) and natural sciences. These recommendations are intended to help the emotional stabilization of victims during psychosocial care following a disaster, by promoting easy, rapid and proactive assistance, and by ensuring the promotion of communication between responders and victims (Vernberg *et al.*, 2008). Those are also underlined to ensuring a good communication at all levels of governance (Pfefferbaum *et al.*, 2012) and by bringing

Identification of the social and psychological impacts	
Before	• Identify the characteristics of the affected population (Vernberg *et al.*, 2008) • Assess social vulnerabilities, the solidity of community ties, economic capacity and the reliability of physical and psychological care systems • Encourage initiatives aimed towards strengthening community relationships and resilience, such as recruiting community members as counselors (Rosen *et al.*, 2010)
During	• Take an interest in the perception of the impact of the event on the affected population to adapt the intervention to it • Encourage community and social interventions while possible (Vernberg *et al.*, 2008) to help make mental health services more consistent with cultural shared norms (Rosen *et al.*, 2010) • Set up an infrastructure and call community members dedicated to psychosocial needs
After	• Offer an early assistance that is helpful and give a positive view of mental health assistance (Vernberg *et al.*, 2008) • Provide psychoeducation to communities affected about stress reactions and coping to reduce distress and promote adaptive functioning (Vernberg *et al.*, 2008) • Integrate comprehensive and integrated policies at all levels of governance (Pfefferbaum *et al.*, 2012)
Management and communication of risk factors	
Before	• Integrate the communication management into the global process and provide sufficient information and long-term communication resources (Vernberg *et al.*, 2008) • Spread information about emergency preparedness to the public • Establish a media infrastructure and sufficient technological resources, to obtain information
During	• Make sure the information is understandable by as many people as possible by including indigenous community members in the management (Rosen *et al.*, 2010) • Divide the intervention into different phases, including rescue phase and relief phase, which can be managed by community members (Rao, 2006) • Ensure pooled and coordinated communication between all the levels of governance and between stakeholders and decision-makers (Pfefferbaum *et al.*, 2012) • Adapt the intervention to the affected population (Vernberg *et al.*, 2008 ; Rao, 2006)
After	• Update the information to be shared based on lessons learned from the crisis and its management (Vernberg *et al.*, 2008) • Ensure the continuity of services provided to victims (Vernberg *et al.*, 2008) • Mobilize and enhance the best practices for recovery and prevention measures including sensitization and education. Make sure to adapt the post-disaster intervention according to the time elapsed since the event (Rao, 2006)
Crisis management	
Before	• Know the type and the factors of vulnerabilities of the exposed population • Know the characteristics of the affected population to be prepared to adapt the intervention to her (Rosen *et al.*, 2010) • Adequately prepare the populations most exposed to the risk of flooding in an appropriate language and make sure your instructions are understandable by all • Undertake a systemic review of the relationships between the context and mental health/well-being, such as the ways in which moderators interact with the context and the mental health system (Berry *et al.*, 2018)
During	• Encourage community members who volunteer for the welfare of the community (Rao, 2006) and provide tailoring activities (Vernberg *et al.*, 2008) • Ensure that an emergency call center is available (night and day) and specially set up for psychosocial needs • Try to stabilize the focus on the reduction of high arousal and emotionality by using strategies that promote stress relief (Rao, 2006) • Provide both physical and psychological comfort as well as activities that increase the community bonds (Vernberg *et al.*, 2008)
After	• Wait for a safe period of time before lifting the new crisis habits • Encourage local repair actions (Norris and Alegria, 2005) • Remain attentive to the needs expressed by the population (active listening, promotion of empathic activities) (Vernberg *et al.*, 2008) • Begin a process to reengage social contacts that are respectful and predictable to limit the loss of landmarks (Vernberg *et al.*, 2008)

Note(s): Those are built upon the various research presented in the paper, and in line with the Sendai Framework (UNDRR, 2015)

Table 2.
Recommendations of key criteria and knowledge to fulfill before, during and after a disaster event

communities together in the implementation of adaptation activities (Norris and Alegria, 2005). Those follow the needs for help seeking and interoperability (Rosen *et al.*, 2010), and for identity support and community cohesion for victims via a division of the care into process stages (Rao, 2006).

Table 2 regroups recommended actions before, during and after the event or crisis, whatever the crisis, through the three key issues: (1) the knowledge of social and psychological impacts, (2) the management and communication of risk factors, and (3) crisis management.

Staying resilient and optimistic, by coping and practicing positive activities that can lead to a good management of the vulnerabilities is the best advice that can be done. For example, making disaster kits before the occurrence of a crisis and staying socially and culturally connected are some of the best pieces of advice we could give (Berry *et al.*, 2018). Examples in Québec (see Figure 4) have allowed to develop action and response package (ex. Guideline and ability to cope) that is designed for people facing extreme weather events, the social workers with those affected and those who want to prevent and reduce the mental health impacts of population-wide disasters (see Lafond *et al.*, 2020).

6. Conclusion

The aim of the paper was to highlight the need and the contribution of cross-sector approaches in a pre- and post-flood context, particularly with regard to mental health and psychosocial impacts. As for other disasters, floods have impacts not only on physical health but also on mental health, with various direct and indirect consequences on the functioning of individual and communities.

Past and ongoing studies in Québec have clearly demonstrated that these effects are not only discernible at short and middle terms, but also are prolonged over longer term, especially when recovery measures are delayed and social and public supports are lacking or not sufficient. People whose homes were flooded or whose movements were compromised have more physical and psychological health problems than those not exposed. They also reveal a positive effect of municipal and community interventions among disaster victims during the planning, intervention and recovery phases (Maltais *et al.*, 2022).

All these impacts stem from, among other things, community, institutional and structural levels. The protective and vulnerability factors inherent in these contexts are mainly concerned, and the direct impacts of disaster are also issued from system organization, which, through domino effects, impacts mental health, as suggested from socioecological models. All these disaster factors of stressors must be taken into consideration in order to build resilience and aid in long-term recovery. Furthermore, emergency psychosocial interventions, coordinated by the organizational model for social and health civil security, are therefore essential to cover this additional dimension. On an individual level, they make it possible to relieve the distress of each person who has been affected or who has witnessed the emergency situation. Collectively, they ensure the maintenance of social cohesion within the affected population. In Quebec, as the case studies revealed, the response to floods at the individual and community level has improved since the advent of the Saguenay floods. Lessons learned have been useful in subsequent floods as well as in the management of COVID and other natural or human hazards. However, much work remains to be done to address some of the gaps, in particular in recovery phase (post-flood) and in main aspects of prevention measures (preflood, as shown in section 3).

In face of any catastrophic situation requiring a multirisk approach, we must recognize that psychosocial impacts greatly affect communities struck by disasters, both in the short and long terms. We must promote the recovery and resilience of affected communities through interventions inspired from past crisis management, a quantitative measure and regular surveys of adaptive coping capacity, and of vulnerability and exposure reduction. Such interventions are inspired by a stepped-care model, which includes psychosocial considerations integrated into

basic services, community strengthening, front-line services and specialized services. It is essential that our recovery efforts for the current COVID-19 pandemic in the months and years to come draw on the lessons learned from previous disasters.

In order to move towards integrated management of risks and impacts on mental health, institutional and structural levels must also be taken into account. Building on Sendai's framework and past and on-going studies in Québec and abroad, key recommendations have been made in order to improve (1) the knowledge of social and psychological impacts, (2) the management and communication of risk factors, and (3) crisis management. Among priorities, we have seen that it is essential to improve capacity building (i.e. preparation and prevention measures) before the occurrence of a crisis and staying socially and culturally connected. Some actions and ability to cope are also strongly helpful, especially those designed for people facing extreme weather events, as well as social workers who want to prevent and reduce the mental health impacts of population-wide disasters (see Lafond *et al.*, 2020).

In definitive, intersectoral works have more and more demonstrated their added values in the management of systemic risks that should concern communities, health and mental health professionals, and the various levels of governance. As climate change is called upon to lead to more systemic risks, close collaboration between all the areas concerned with the management of the factors of vulnerability and exposure of populations will be crucial to respond effectively to damages and impacts (direct and indirect) linked to new meteorological and compound hazards. This means as well to better integrate the communication managers into the risk management team.

One of the key recommendations concerns also stable and ongoing support from governmental and health authorities. The financial and psychosocial interventions and recovery measures will have to be reinforced and adapt to new climate and socioenvironmental realities. In Canada, systemic risks will occur from combined climate-related disasters whereas the warming trends will be two to three times the rate at the global scale (CCA, 2019; Bush and Lemmen, 2019; IPCC, 2018, 2019). The recent study on Canada's top climate change risks (see CCA, 2019) has also revealed the human health and wellness is part of the top six areas of concerns, due not only to change in hydrometeorological hazards but also from increasing ranges of vector-borne pathogens (see Ogden and Gachon, 2019; Rees *et al.*, 2019). That's why no one can ignore that systemic risks constitute one of the major collective challenges that we need to tackle over the following decades, in combining all efforts whatever the disciplines and sectors.

Note

1. In this sense, systems are understood as a set of interactions of complex factors, aimed to construct synergistic analytic skills, to predict behaviors and interventions necessary to reduce the risk and produce outcomes to help resilience (Berry *et al.*, 2018).

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