Chapter 6
Climate Change and Extreme Hazards

Introduction

There is a growing popularity of data-driven best practices in various fields—such as climate change, biodiversity, and pollution; ensuring nutritious, healthy, and sustainable food; and societal transformations due to the rise of artificial intelligence and other next-generation digital technologies (European Commission 2019b). A best practice is a technique or methodology that is generally accepted as superior to any alternative because, through experience and research, it has proven to be reliable leading to a desired result through evidence-based approach. Despite the fact that data and research are very important, it is simplistic to conclude that they are sufficient to improve practice. Expertise and intuition, as claimed in the previous chapter, are fundamental to reach the best solution to the problem. This is the reason why we give space to explain in the next paragraph why evidence-based and experience are so important in medicine. As a matter of fact, evidence-informed for policymaking has been borrowed from medicine and we hope it can still be borrowed from medicine, but with a more mature awareness to move faster from theory to practice on the ground.

Evidence-Based Medicine and Clinical Practice

“The Evidence-based approach to clinical practice is to identify a treatment of interest; conduct carefully controlled studies, ideally using a double-blind paradigm; determine the effectiveness of the treatment; and disseminate the results in the form

The chessboard is the world, the pieces are the phenomena of the universe, the rules of the game are what we call the laws of Nature. The player on the other side is hidden from us.

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of best practices in the form of rules, such as ‘If X, that do Y’” (Klein et al. 2016:244). For physicians working in a complex, dynamic environment with high time pressure, uncertainty, and risk, evidence-based medicine (EBM) may appear as a salvation. However, Klein and his colleagues (2016) identified six cognitive challenges for clinicians, who want to apply EBM in their daily practice:

1. **Characterizing problems**: Applying without criteria the EBM may lead to an inadequate detection and identification of the problem. Not paying attention to the variability offered by certain condition categories and to the nature of other interacting problems, conditions and treatments may result in an undervaluation of the diagnostic expertise of the physician that is an essential trait of the healthcare system. The best practices implied by physicians in their work rely on categorizations to organize knowledge, but these are limited when a practitioner is confronted with reality (variety, time course, treatments, interactions across various diseases).

2. **Gauging confidence in the evidence**: “too often the choice of treatment depends on judging the quality and relevance of the evidence, judgments that often depend on experience and are made under uncertainty and time pressure” (Klein et al. 2016:245). Evidence can also be misleading: the moment of data collection may have been influenced by variables that were not understood or not “correctly treated”. Researchers may be unaware of the variables that may interact with the results and, thus, the medical community must be ready to discuss and revise its solid faith in evidence.

3. **Best practice in conflict with expertise**: The medical community is thought to develop over years expertise and acquire pattern-based repertoires to judge the ongoing situation. Occasionally, this may cause a conflict between best practice and professional judgment because a fail due to the misleading of a best practice causes a greater stir. Rather a good outcome could be produced by taking a personal decision based on judgment instead of blindly following a procedure.

4. **Applying simple rules to complex situations**: It goes without saying that complex situations contain variables that cannot be predicted by simple set of rules. “Rules and evidence are about populations, but physicians have to treat individual patients” (Klein et al. 2016:247). The variables, that the single patient present, interact and vary over time as the patient’s status changes and the physician has to take all the conditions into account (comorbidities, low blood pressure, diabetes, asthma, etc.), performing trade-offs that also reflect the characteristics and the lifestyle of the single patient.

5. **Revising treatment plans that do not seem to be working**: As the patient status changes over time, developing additional symptoms or problems, the treatment should be changed consequently. “Plan revisions places great demands on expertise in understanding the treatment regimen and the individual patient so that revisions can be made quickly and effectively” (Klein et al. 2016:248). This also requires that the physician should have the ability to understand when the plan is not working, when more time has to be given in order to give it a chance to
work, or when the plan has to be changed before the patient’s conditions are worsened.

6. **Considering remedies that are not best practices:** For example, the medical community should be ready to apply also the results produced by the metadata of certain unsuccessful studies as these data reflect a particular subpopulation to which the patient belongs with whom they are currently working. “Although one would like to make decisions based only on the most rigorous evidence, in the real world, there are always constraints from limited resources and time pressure” (Klein et al. 2016:249). A related challenge is the primary role played by practitioners themselves, who contribute to the progress of medicine by being enough brave to test new solutions in extreme situations without initial randomized control trials.

The current list of six challenges underlines that expertise cannot be expressed in the form of strict, acritical set of rules, but it has to be supported by rules to properly function. “Evidence … does not speak for itself. It has to be interpreted, revised, and tailored to specify context and conditions, all of which takes expertise” (Klein et al. 2016:250). EBM works smoothly when the evidence is clear and directly applicable to the patient, but in challenging situations, the practitioner has to rely on his or her own judgment and expertise in order to solve the problem. In order to help physicians/clinicians with their struggle between best practices and expertise, the cognitive engineering community developed methods to nurture decision-making processes to improve patient care without falling in the trap of blindly applying best practices. It focuses on layering best practices with experiential knowledge of different situations to handle and resolve different kind of problems regardless of variability, uncertainty, and change. The cognitive engineering research suggests eight directions for strengthening best practice strategies (Klein et al. 2016):

1. Develop and sustain expertise.
2. Support adaptation.
3. Combine evidence with experience.
4. Balance generic evidence with experiential evidence.
5. Represent evidence.
6. Appraise evidence.
7. Share evidence.
8. Support collaborative decision-making.

Best practices are an important opportunity for any community, category, disciplines, organization, etc., because they enable actors to behave in consistent and coherent ways. They also provide evaluation, discussion, and advancement. However, best practice approaches may oversimplify the cognitive, emotional, and motivational challenges when confronting specific complex situations under uncertainty and ambiguity (Galluccio 2011, 2019; Klein et al. 2016).
Climate Change and Hydrometeorological Extreme Hazards

The challenges posed by climate change are enormous. The increasing frequency of climate extremes has many consequences. One area where these conditions manifest themselves is hydrometeorological hazards (Galluccio 2019). Climate change is one of the main priorities of the EU’s global agenda. The repercussions raise geopolitical questions, and have implications for livelihood and development. Climate change requires a strategic coordinated One Heath concept’s response from international and national bodies to ensure health security, sustainable development, territorial integrity, and access to resources (water, food, energy to name but a few). Scientists and policymakers around the world are in agreement to state that climate change is acting as a multiplier and even as a main trigger for threats to international peace and security. Climate change has been identified as the “ultimate threat multiplier” by the G7 held in 2011\(^1\) and seven compound climate-fragility risks have been identified:

1. Local resource competition
2. Livelihood insecurity and migration
3. Extreme weather events and disasters
4. Volatile food prices and provision
5. Transboundary water management
6. Sea-level rise and coastal degradation
7. Unintended effects of climate policies

The only efficient way to manage this multilevel threat is integrating policies and programs to help strengthen resilience to climate-fragility risks and realize significant benefits for the world population. The international agenda should implement cooperation at international level through the science diplomacy pattern. The European Environment Agency underlines that human health and well-being are intimately linked to environmental quality and, thus, environmental policies are strongly required to improve the state of public health and well-being (European Environment Agency 2014). After having renewed its votes with the signature of the Paris Agreement in 2015, the EU is struggling to accomplish its aim of drastically reducing its carbon emissions. The Sustainable Development Goals (SDGs) aim at limiting the global temperature increase by 1.5 °C above pre-industrial levels by integrating effective responses to climate security risks across policy areas: climate action, resilience building, preventive diplomacy, improved risk assessment, and risk preparedness. The European Council of the EU, moreover, recognizes “the commitment of the EU to cooperate and to exchange experiences and lessons learnt with its partners in accelerating effective policy implementation, including through initiatives such as the NDC\(^2\) partnership, while stressing the EU’s engagement to

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\(^1\) For further information, refer to: https://www.newclimateforpeace.org/#report-top.

\(^2\) Nations have their commitments to the Paris Agreement through Nationally Determined Contributions (or NDCs)—each country’s strategy to cut its own greenhouse gas emissions and
deliver its pre-2020 climate change commitments” (EU Council 2018:4). In the same document it is stated that the EU is continuing to scale up the mobilization of international climate finance “as part of the collective developed countries’ goal to jointly mobilize USD 100 billion per year by 2020 through to 2025 for mitigation and adaptation purposes, from a wide variety of sources, instruments and channels in order to assist developing countries in implementing their climate change adaptation and mitigation plans” (EU Council 2018:5). Moreover, the Council highlighted the critical role of non-state actors as recognized by the Paris Agreement through the Global Climate Action Agenda and by the 2030 Agenda for Sustainable Development.

**Negotiating Global Agreements with Incomplete Evidence-Informed Policies**

Oceans represent a great challenge for coping with hydrometeorological hazards and ecological issues. Not only are they important due to economic and population considerations, but they also absorb and recycle most human waste products. Industrial quantities of nitrogen and phosphorus waste produced by agricultural fertilizers and human and animal excrement exceed most of the absorbing ability of ocean ecosystems. In addition, oceans regulate the distribution of heat and moisture through ocean circulation, and most of the rain seen in human fields and settlements stems from the moisture and evaporation of oceans. This makes humans inherently dependent on the ecosystems and distribution patterns of the world’s oceans, especially when it comes to rainfall and access to freshwater, which is negatively affected by climate change. Acidification due to CO₂ emissions has also contributed to difficulties of skeleton growth and reproductive disorders in marine animals and some fish. This all leads to the deterioration and fragility of ocean ecosystem resilience. Richard Smith states in his book *Negotiating Environment and Science*, “agreements dealing with global environmental issues often must be concluded on the basis of incomplete and uncertain information to avoid waiting until environmental damage becomes irreversible” (Smith 2009:150). This condition of course claims for a higher effort from negotiators, who need to be convinced “that the commitments being undertaken are based on sound science as it is understood at the time of negotiation, while recognizing that in most instances the relevant scientific knowledge is still evolving” (Smith 2009:150). Moreover, in this context major scientific ventures were recognized to receive higher benefit from a cooperative international approach which should include as many countries as possible. Smith (2009, 2015) recollects his almost 10-year experience as the principal deputy assistant secretary in the State Department Bureau of Oceans and International Environmental and

build resilience against the negative effects of a changing climate. [https://ndcpartnership.org/about-us](https://ndcpartnership.org/about-us).
Scientific Affairs (OES) of the United States through the analysis of eight successful negotiations. The aim of the author is to show the potential of diplomacy as a profitable tool for dealing with specific environmental issues, such as the deterioration of the ozone layer that could be solved only by a coordinated action by all the major developed and developing countries (Montreal Protocol (1987, in Smith 2015)) or the control of the sulphur and nitrogen dioxide-driven acid rains between Canada and the United States (Air Quality Agreement (1991, in Smith 2015)), or with broader scientific matters, such as the global scientific improvements driven by the basic scientific research (US-URSS Science Agreement (1988, in Smith 2015)), which was also a signal of the more relaxed relations between the two opposing blocks. A negotiator of environmental issues has to bear in mind also the substantial role played by stakeholders, who, under certain circumstances, should be included in the discussion of the issues. The negotiator should—at least—listen carefully to the people at the very end affected by the negotiation, to their representatives, and to the related non-governmental organizations (NGOs) in order to put all the interested parties on the same path leading to the success of the agreement. The agreement should be implemented on certain yearly basis because due to the continuous changes occurring in the environment, there should be constant modifications after the implementation of certain regulations. Such agreements must not only make sense in the light of the existing state of scientific knowledge but also include a process for the regulation. Moreover, in order to reach a successful agreement, during the negotiation with foreign partners, it is necessary to involve all of them in the idea that they are working all together to deal with an issue that concerns them all (Smith 2009:149). The chance to achieve this result will increase if negotiators are able to organize informal work meetings instead of overusing plenary sessions, where counterproductive restatements of entering positions are encouraged. Smith (2009:156–157) leaves us a legacy of a man that knows what he is talking about (he negotiated with diplomats, politicians, and scientists) with a gentle but assertive behaviour, with the hope that if we cooperate all together we will be able to face these challenges step by step in a sustainable way:

The world will be facing some serious environment and science challenges in the years ahead. In addition to global warming, developments in such fields as nanotechnology and biotechnology will pose new problems. More will need to be done to limit emissions of individual pollutants, such as ground-level ozone and particulates. Desertification and the loss of tropical forests, biodiversity, and coral reefs will remain on the agenda. A continuing and alarming collapse of fisheries around the world will have to be addressed. Further, we will need to find ways to continue moving forward with cooperation on major science projects, such as space research, the development of fusion power, and advanced supercolliders. Moreover, we can be sure that other environment and science issues not now environment and science issues not now envisioned will arise. In many cases, the challenges to be faced will require a coordinated multilateral response. On the basis of what has been accomplished, there are some grounds for optimism that those challenges can be met (Smith 2009:156–157).
Climate Change: Citizens’ Resilience and Well-Being

Many of the consequences of hydrometeorological hazards are psychosocial, especially when it comes to human well-being. Tying the individual and social responses to hydrometeorological hazards from a psychological standpoint is important to measure the potential loss of emotional, cognitive, and motivational well-being in the case of environmental disaster. Given the stress potential generated by these hazards, a cooperation between scientists and policymakers is deemed of vital importance to produce evidence-informed studies and research on how to assess and deal with vulnerability and resilience to help a population’s ability to cope with hazards (Galluccio 2019). Resilience is essential to minimize vulnerability in a world increasingly affected by hydrometeorological hazards. Developing resilience in communities is tied to ecological, psychological, and social concerns that must result in solid natural, mental, and social capital, and collective efficacy. Communities and individuals react differently to these events in relation to their frequency and intensity. In addition, factors of emotional styles such as personal outlook, resilience, social intuition, self-awareness sensitivity to context, attention, and location, class, gender, ethnicity, and age also determine an individual or community’s degree of vulnerability to the stress in these risk situations. Key policymakers are increasingly seeing mental health as an important component of the psychological resilience in the face of extreme hazards, as scientists have been persuading them with strong evidence-informed policymaking. International actors and the EU are beginning to tie mental health to physical health, education, regeneration, crime reduction, community cohesion, sustainable development, employment, culture, and sports. As a matter of fact, cultural and social narratives heavily influence the impact of hydrometeorological hazards on stress and well-being. Trauma is intergenerational. In contemporary societies media narratives and information technologies facilitate sensationalism and negative reactions even in resilient communities physically unaffected by hazards (we witnessed same negative effects during the COVID-19 crisis). In the latter case, social media can produce instant and vivid images from disaster areas and lead to feelings of anxiety and fear. Climate extremes have a strong psychological impact in direct and indirect ways. Directly, extremes can cause mental and physical health injuries due to the intensity of hydrometeorological hazards. Indirectly, cognitive responses such as anxiety towards future risks and world phenomena, as well as hopeless mental states, could bring depression and post-traumatic stress disorder (PTSD) which can be just as devastating for the human mental capital and well-being (Doherty and Clayton 2011; Galluccio 2019). Resilience is also a prime concern for many of the EU’s regions given the high likelihood of hydrometeorological hazards. Both financial and non-financial costs such as loss of life and well-being are at the centre of these concerns. Over the last few decades, the EU has faced an increasing number of economic, geopolitical, social, and climate challenges, forcing member states to find common solutions. At a European level, working groups exist for the most relevant hydrometeorological risks such as floods, droughts, and adaptation. True to the principle of subsidiarity, the Commission’s activities place member states as the primary and
initial responders in the event of a crisis or disaster. The EU scientists and politicians/diplomats have heavily influenced international initiatives in Disaster Risk Reduction (DRR) such as the Hyogo and Sendai Frameworks. Given its importance in Europe 2020 objectives, the EU has incorporated resilience into 16 different policy areas. These include frameworks for civil protection and disaster risk due to hydrometeorological hazards, food security and humanitarian issues, and structural reforms that will guarantee financial and economic stability in the event of a crisis. The EU has also established projects to combine responses to pandemics and endemics within and outside its borders. Despite efforts, there is a widespread view that investment and policymaking are currently insufficient to cope with resilience and vulnerability challenges. New comprehensive approaches should have even larger multilayer approaches, further combining psychological, social, economic, and environmental concerns with scientific findings. The Commission’s Joint Research Centre (JRC) has been working hard to ensure that scientific data and evidence are available for resilience policymaking. It is developing pilot programs for risk reduction, analysis, scenario building, and impact assessment for the EU to be better prepared for future events using a multidisciplinary approach, as systemic risks tend to need. Regional vulnerability in the EU is understood as a territory’s exposure sensitivity and response capacity to events related to climate extremes and natural hazards. To put it more clearly, this implies detecting degrees of exposure by calculating:

1. **Sensitivity**: the economic, social, and ecological potential damage calculated by regional GDP per capita financial damage potential, how many people can be affected by events, and the extent of exposed environmental assets
2. **Response capacity**: the ability to react and mitigate
3. **Exposure**: calculated by the degree, duration, and/or extent to which the system is in contact with, or subject to, a disturbance such as climate change
4. **Susceptibility**: the extent to which a system is affected by events

Throughout this brief analysis we have focused our attention on the importance of resilience and vulnerability issues from ecological, social, and psychological perspectives as they pertain to hydrometeorological hazards. It is clear from international, national, and regional actors that disaster preparedness and response coordination must be handled by scientists and politicians/diplomats together working elbow to elbow focusing on strengthening local communities both in Europe and abroad. Developing resilience in local communities means assessing their mental and social capital, and collective efficacy in the creation of networks and cultural narratives on hydrometeorological hazards and extremes. The strengthening of collective leadership during the prevention, response, and post-crisis phase of hazards could be extremely important. Natural disasters represent potential traumatic events; not only do hydrometeorological hazards threaten the global economy and societies at large, but they can also heighten stress levels compromising populations’ well-being. Moreover, strengthening platforms for psychologists, anthropologists, sociologists, meteorologists, ecologists, and other resilience stakeholders in hydrometeorological hazards could be a great action to develop a people-centred prevention, response, and disaster risk reduction.