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Lo sviluppo della cooperazione internazionale in caso di catastrofi: il "Centro per le scienze delle catastrofi, forensi e biometriche"

Faire avancer la coopération internationale dans la gestion des cas de catastrophes : le « Centre des sciences des catastrophes, médico-légales et biométrique »

Advancing international cooperation in disaster response: the "Center for Disaster, Forensic, and Biometric Sciences"

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Riassunto

Nel nostro mondo interconnesso, le crisi e le catastrofi solo raramente restano confinate all'interno dei confini nazionali, ma spesso colpiscono cittadini di diversi paesi. Inoltre, quando si verifica una catastrofe di grandi dimensioni, un paese può non possedere tutte le risorse necessarie per gestire le conseguenze. Una complicazione ulteriore riguarda il fatto che l'incidente può avere danneggiato gravemente, o addirittura distrutto, anche le infrastrutture necessarie per gestire l'emergenza, rendendo la risposta e il ripristino della situazione precedente una sfida impari.

Una catastrofe di massa, che produce un elevato numero di vittime, necessita di collaborazioni internazionali i cui partner devono utilizzare un linguaggio medico-legale comune e un sistema unificato di raccolta, condivisione e comparazione di dati e informazioni. Riconoscendo l'importanza di un approccio cooperativo nell'ambito della gestione delle catastrofi, il "Centro europeo di medicina delle catastrofi" ha recentemente costituito un gruppo di lavoro dedicato al fine di creare un centro specializzato, denominato "Centro per le scienze delle catastrofi, forensi e biometriche", focalizzato sullo sviluppo di norme e di linee guida per la gestione delle attività medico-legali in casi d'urgenza, di catastrofi e di attacchi terroristici. Il presente articolo mira ad analizzarne le origini, gli obiettivi, gli scopi e gli organismi che partecipano a questa nuova entità.

Résumé

Dans notre monde interconnecté, les crises et les catastrophes ne se confinent que rarement aux frontières nationales, affectant souvent des citoyens de plusieurs pays. De plus, lorsqu'une catastrophe majeure survient, un seul pays peut manquer des ressources nécessaires pour gérer les conséquences. Complication supplémentaire, l'incident lui-même peut avoir gravement endommagé ou détruit les infrastructures d'urgence, rendant la réponse et la récupération un défi redoutable.

Une catastrophe de masse, qui implique un grand nombre de victimes, nécessite une collaboration internationale, utilisant un langage médico-légal commun et un système unifié de collecte, de partage et de comparaison de données et d'informations. Reconnaissant l'importance d'une approche coopérative en matière de gestion des catastrophes, le « Centre européen de médecine des catastrophes » a récemment formé un groupe de travail dédié, visant à créer un centre spécialisé, connu sous le nom de « Centre des sciences des catastrophes, médico-légales et biométriques », axé sur le développement de normes et de lignes directrices pour la gestion des activités médico-légales en cas d'urgence, de catastrophes et d'attaques terroristes. Cet article vise à esquisser les origines, les objectifs, les finalités et les organismes participants à cette nouvelle entité.

Abstract

In our interconnected world, crises and disasters rarely confine themselves to national borders, often affecting citizens from multiple countries. Furthermore, when a major catastrophe strikes, a single country may lack the necessary resources to handle the consequences. Complicating matters, the incident itself may have severely damaged or destroyed emergency infrastructures, making response and recovery a formidable challenge.

Mass disaster (MD) involving many victims requires multinational collaboration, utilising a common forensic language and a unified system for gathering, sharing, and comparing data and information. Recognizing the importance of a cooperative approach to disaster management, the "European Centre for Disaster Medicine" has recently formed a dedicated Work

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Group aimed to establish a specialised centre, known as the "Center for Disaster, Forensic, and Biometric Sciences", focusing on developing standards and guidelines for the handling of forensic activities in emergencies, disasters, and terrorist attacks. This paper aims to outline the origins, objectives, purposes, and participating bodies of this new entity.

Key words: crisis; disaster management; disaster response; forensic activities; mass casualty management; victim identification.

1. Introduction

Disasters, whether they result from natural forces or human actions, pose perpetual threats to human lives, infrastructure, and the overall well-being of societies worldwide. As the world becomes increasingly vulnerable to a wide range of catastrophes, there is an urgent need for effective disaster management strategies. Natural hazards, as well as accidental or man-made disasters, can cause catastrophic damage and significant socio-economic losses. Unfortunately, the actual damage and losses observed in recent decades have shown an increasing trend. Therefore, disaster managers must take increasing responsibility to proactively protect their communities by developing efficient management strategies. Recent studies document the application of Artificial Intelligence (AI) to process disaster data covering all phases of disaster management (i.e., preparedness, response, and recovery) and leading to a faster and equipped response.

Technical and methodological improvements in disaster research are a critical issue, for which AI applications [1] prove to have significant implications. Not by chance, researchers use various technologies to assess hazards and disasters through a multidisciplinary approach, using both quantitative and qualitative data collection and analysis strategies. Numerous studies have shown indeed how integrating algorithms and AI approaches may improve situation assessment, decision-making and coordination between the various stakeholders, enabling greater visibility of the network dynamics of complex disaster management and humanitarian actions.

In recent years, the public has been involved in managing MD's from crowdsourcing apps developed to manage data collection activities across social media platforms and increase disaster awareness using serious gaming apps. Smartphone apps are gaining popularity among emergency responders and healthcare professionals, as well as the general public. Thousands of medical apps are now available for smartphones and tablets, including textbook applications, guidelines, drug databases, and much more. A systematic literature review by Bachmann and colleagues (2015) identified several valuable apps for public use, including well-designed alerting and educational apps: the search revealed as many as 683 applications and was narrowed down to 219 based on relevance to the sector. This is an ever-expanding catalogue of applications related to Disaster Medicine, within which it is difficult for the non-expert public and the rescuers themselves to find their way around. At present, smartphone applications to support healthcare are really proliferating.

This pressing need coincides with remarkable advancements in forensic science and biometric technologies, which collectively necessitate the establishment of a dedicated international centre. This scientific paper presents an in-depth project proposal for the creation of the International

"Center for Disasters, Forensic, and Biometric Sciences" (CDFBS), a visionary institution poised to address the global challenges of our time. The requirement to set up disaster response training centres under the aegis of international bodies, in order to mitigate the devastation of disasters, to provide a thorough assessment of relief efforts and to provide regular training for rescue teams, and the mobilisation of humanitarian aid is not a new issue, having already emerged at least fifteen years ago. Documented experiences in Southeast Asia have shown that humanitarian efforts have often been hampered by the rejection of national authorities in the name of "national sovereignty". Such problems claim a widely accepted, politically neutral, well-coordinated and effectively governed organisation in the areas affected by the critical event.

The feature of the rising CDFBS is the strong vocation for study, research, sharing and dissemination of knowledge, at international level, with reference to specific issues of disaster management, active participation in humanitarian efforts to mitigate suffering and facilitate the rehabilitation of affected communities. The philosophy behind the creation of the Center could be summarised by the title of Hilhorst's (2014) monograph "Complexity and diversity: unlocking the social domains of disaster response", which underlines the need to systematise the best knowledge and skills on the subject while respecting the peculiarities of each critical scenario. Stoykov (2013) was in total agreement when, in his presentation of the NATO Center of Excellence – Crisis Management for Disaster Response, identified the three key points of Smart Defense as cooperation, coordination and communication. Within this conceptual framework, the CDFBS focuses its interest on the specific issues of the management of mass casualties and the identification of human remains, thanks to the use of modern forensic investigation methodologies and biometric technologies.

Disaster Victim Identification is a police activity aimed at recognizing the bodies of people who have died in large numbers in disasters, calamities, or other nefarious circumstances. This activity is internationally known by the acronym DVI. When a major disaster occurs it is important to consider that, one country may not have sufficient resources to cope with mass casualties; disaster may also have heavily damaged emergency infrastructures making the task of identifying victims even more difficult. A coordinated effort by the international community can accelerate the process of recovery and identification of victims, allowing families to begin the healing process, society to rebuild, and in cases of terrorist attacks, to identify possible attackers. These needs were translated into an intervention plan at the initiative of INTERPOL, which in 1980 gave rise to DVI Protocol by issuing a series of Recommendations aimed at creating a specialised Team with DVI functions at national level, to cooperate at the scene of disasters with experts from the victims' country of origin in identification work. The high number of simultaneous casualties is the element giving exclusive competence to these teams [2].

In MD situations, positive identification of human remains is a pivotal task performed by forensic scientists, namely pathologists, biologists, crime scene investigators, odontologists, fingerprint experts and anthropologists. The identifying victims process is carried out with scientific methods, starting from the phase of recovering the remains, analysing them and interpreting the signs of mechanical trauma. The use of Forensic

Anthropology techniques allows the reconstruction of the subject's life through elements such as age, sex, race and height, which may be crucial for cross-sectional analysis. A properly managed Death Investigation System (DIS) requires an adequate investment of financial resources, mostly in fatal events with multiple victims. Sadly, the recent economic crisis has resulted in cuts in public spending, which have also affected DIS services, making it difficult to conduct death investigations in accordance with international standards. The situation is particularly critical in countries with limited financial resources, where DIS often faces structural, cultural and socioeconomic problems.

2. Overview

The CDFBS sets out to accomplish a multifaceted array of objectives. The heart of the Center's mission is to serve as a catalyst for collaborative research that drives innovation in disaster management techniques, elevates forensic investigation methodologies, and propels the evolution of biometric technologies. Researchers from diverse corners of the globe will converge at the CDFBS, forming an intellectual powerhouse where novel solutions to mitigate the impact of disasters are cultivated and tested. Research and development are needed to further find the right balance between these elements [3].

Human remains detection dogs (HRDD), specially trained to find the scent of human decomposition and alert their handler to its location, appear to be a valuable resource to invest in. They are used by law enforcement in many contexts (homicides, natural and man-made disasters to search for human corpses, body parts or fluids) – activities usually gathered under the term "necrosearch". Since the training of detection dogs depends on the quality of the available training aids, HRDDs should be trained with aids that imitate the smell of a human corpse. Unfortunately, the aids currently available on the market are poorly representative of the smell of a decomposing corpse. Biological aids have proven to be more efficient and reliable than synthetic aids for this purpose. However, biological aids are difficult to obtain due to ethics, legislation and biohazard to both humans and dogs. This limitation can largely be overcome, since San Marino health legislation allows the use of human biological materials for the training of cadaver-detection dogs, albeit with limitations. The main use of aids of human origin complies with scientific recommendations, also meeting biological risk and ethical criteria. For these reasons, the CDFBS could become a privileged hub for the training of HRDDs, as well as a favourable environment for studying the impact of the animal-human bond on disaster management, given that search and rescue teams with dog units face physical and emotional demands that affect both the handler and the animal.

Training and capacity development of professionals involved in search and rescue operations is a crucial area for the CDFBS, which will be committed to providing specialised training programs, workshops, and conferences. These initiatives are meticulously designed to empower individuals and agencies engaged in disaster management, forensic science, and biometrics. By equipping them with advanced knowledge and skills, we will enable them to respond to crises with precision and confidence. Studies on the subject show that community-based disaster preparedness approaches are essential to reduce vulnerability in disaster management when associated with a policy that improves population skills through local resource exploitation. The

development of strategies to improve the resilience of affected communities is among the aspects emphasised in the action framework of areas of Southeast Asia, due to their frequent exposure to catastrophic natural events. Capacity building programs on resilience are more necessary than ever since a recent review of the literature of Bhagavathula and colleagues (2021) revealed the scarcity of skills in this area.

Developing the capacity of local governments to respond to emergencies has become a key topic in the MD discourse, as it has a profound impact on people's lives, the security of property, and a range of other rights. A primary component of disaster response is training. Repeated exercises over time provide first responders with the knowledge and skills necessary to be prepared when disasters strike. However, traditional training methods, such as high-fidelity simulations (e.g., real-world drills) and classroom courses, may not provide effective training for today's challenges. Technological advances offer a wide range of opportunities for training through computer-mediated simulations and exercises, including the use of mixed reality games and wearable computers. Existing studies report the usefulness of these technologies for training purposes: Sherman and colleagues (2020) tested the importance of a generalised sense of power - the belief in one's ability to influence others in various social relationships - as a psychological resource for exercising leadership in unfamiliar, high-risk group challenges such as emergencies or crises. The results showed that individuals who took part in the simulated crisis with a greater awareness of their interpersonal skills experimented less stress., behaved more assertively and ended the simulation with a relatively high desire to lead, even though they were not considered better leaders by their teammates.

The CDFBS envisions itself as a centre for knowledge accumulation and dissemination. It will create a vast repository of valuable resources, including case studies, best practices, and technological advances. This value of information will be easily accessible to researchers, practitioners, and policy makers around the world, fostering a culture of continuous learning and improvement. According to recent studies, the use of information technology in different phases of disaster management has ambivalent consequences - benefits but also potential drawbacks - due to the lack of a holistic perspective. Given that information systems (IS) play an essential role in recording, exchanging and using information, researchers argue for the importance of a comprehensive strategy of technology use in the various phases of disaster management, as well as the need for standardised data to share advice among stakeholders. In the event of a disaster, the roles of IS (information recording, exchange and processing) are crucial for effective crisis management: information recording is functional in a preventive capacity, while information processing becomes crucial for relief operations. The exchange of information between stakeholders is the key element of both phases. Unfortunately, an integrated discussion on the use of technology in the global crisis is currently lacking, as the discussion focuses separately on the 'before' and 'after' disasters.

Experts advocate the need for a holistic strategy to ensure its effective use during the disaster management phases by fostering collaboration with external institutions and professionals. Such a strategy requires a long-term perspective, whereas

disaster management is faced with an urgent short-term problem: this represents one of the challenges that the CDFBS might be called upon to address. Steelman and colleagues (2014) speak of an 'Infocentric Analysis' to define an information market with its information needs, that means to identify information providers and mechanisms for information exchange; to map the information exchange network and diagnose its flaws. These are essential steps to describe the information flow, identify complications and propose solutions to correct information problems during an MD.

The CDFBS will play a central role in the definition of international policies and standards in disaster management, forensic science and biometrics. By facilitating harmonisation efforts between different stakeholders, the Centre will contribute to the development of common frameworks that improve interoperability in these critical areas. Natural disasters put such a strain on the capabilities of emergency services hence the national governments and international institutions stress the importance of shared responsibility, i.e., the idea that all institutional actors have specific obligations in managing adverse events and must work collectively to reduce disaster risk. A review of the literature on the topic by Lukasiewicz and colleagues (2017) shows how the exact balance between individual and governmental responsibility has not yet been established, indeed it is continuously contested, especially after major events. This raises several pertinent questions: are there areas of shared responsibility between the different actors in disaster management? Is it necessary for them to act together? Is credible cooperation possible? Is it possible to assign responsibilities clearly and effectively? Therefore, there is an urgent need to identify the responsibilities of each of the international actors involved in disaster risk management.

Recognizing the urgency of immediate and coordinated responses to disasters, the CDFBS is committed to actively engage in disaster response efforts. It will provide technical expertise, resources, and coordination to affected regions in close collaboration with governments and humanitarian organisations, bolstering global efforts to alleviate the suffering of disaster-affected populations. The field of Humanitarian Logistics and Supply Chain Management (HLSCM) has recently attracted the attention of a variety of stakeholders, such as scholars, practitioners, and policymakers, demonstrating broad consensus on the need for improved humanitarian operations and crisis/disaster management. Combining information from field research findings, the need has emerged for preparedness and prevention on the matter to be addressed by academics and/or competent institutions. Furthermore, the supply chain context should be jointly analysed to discuss coordination between aid members, to assess resources and capabilities of actors involved in humanitarian operations.

The establishment of the CDFBS promises a multitude of benefits for the global community, transcending geographical and cultural boundaries. It is widely believed among experts that the identification of key MD knowledge factors is an enabler for successfully managing a critical event. The mapping of key factors in managing critical events will be done through the acquisition of best practices and lessons learnt. The Centre could position itself on the international scene as a virtuous rescue institution, applying state-of-the-art knowledge on risk mitigation and disaster effects, developing an accurate assessment of pre- and post-

disaster relief in the field, providing training to rescue teams and forensic scientists for the recovery of victims and identification of human remains. One of the main dividends of the CDFBS's existence will be the innovation fostered in disaster management, providing nations with cutting-edge strategies to improve their preparedness and response capabilities - which will result in lives saved and less economic impact following disasters. Effective training is a cornerstone of disaster preparedness worldwide. The quality and frequency of disaster training have a significant impact on the perceived preparedness of potential rescuers. During a disaster, the ability of rescuers to adequately cope with the situation is determined as much by their pre-existing knowledge and skills as by their mental and physical state and familiarity with similar scenarios. The literature agrees that during high-impact, low-probability events, the appropriate response of personnel is based on their ability to perform their assigned roles. Comparative research between virtual reality-based and traditional training modalities may be appropriate to explore various aspects of realism and cost in disaster preparedness.

In the field of forensic science, the CDFBS will facilitate the adoption of best practices and advanced technologies through knowledge exchange and collaboration. This will result in more accurate and efficient processes, particularly in cross-border cases where coordination and standardisation are crucial. Large-scale forensic investigations pose several unique challenges, different from those of national investigations, that force scientists into practices not customary when working in a standard criminal justice system. They may include determining the number of victims, creating ad hoc working protocols, negotiating the form the investigation will take with the various stakeholders, considering the cultural beliefs that concern the surrounding society regarding the dead and missing, and working within prescribed economic, political and time constraints, among others. Forensic scientific responses to these challenges must prove flexible, innovative and be constantly evolving. At the forefront of biometric research and development, the centre will focus on improving the reliability and interoperability of biometric technologies such as fingerprints, DNA analysis, facial recognition and iris scanning. This will strengthen global security by ensuring the operation of these technologies across borders. Scientists have long been discussing how the fields of biometrics and forensic science can contribute and benefit from each other, with the aim of promoting the development of new methods and tools that improve current biometric forensic applications, mainly in mass disasters and multiple victims of terrorist attacks.

The Centre aims to implement the development of professionalism in the field of MD search and rescue activities (SAR). Therefore, the CDFBS training programs will enable professionals to develop skills needed to manage disasters, conduct forensic investigations and effectively use biometric technologies. This investment in human capital will generate long-term public safety dividends. Resilience to complex events is the result of multiple factors besides psychological ones, such as the use of social networks and local culture, which must be considered in the process of evaluation and planning. Adopting a multidisciplinary perspective for disaster response, applying a socio-ecological approach to risk reduction, is currently seen as the winning approach to implementing the capabilities of those involved in MD management.

The Centre will serve as a unifying platform for promoting international cooperation, enabling countries to share experiences, resources, and expertise. This collaborative spirit will lead to more effective global coordination in disaster management, law enforcement and humanitarian aid efforts. The relevance of international cooperation in responding to adverse events in terms of disaster mitigation, technology transfer and training is well documented in the literature of the last four decades, sharing of relevant information and receiving assistance. As international cooperation is also crucial in building a humanitarian assistance network in the MD, active participation in humanitarian efforts will become a distinctive feature of the CDFBS, strengthening the capacity of the international community to respond promptly and effectively to disasters, resulting in timely delivery of aid, mitigation of suffering and restoration of affected communities. Victim management (CM) must be timely and efficient in order to significantly increase their survival rate: it, however, faces uncertainty about the location of the disaster, the disruption of transport networks, the scarcity of resources and possible deaths of rescue teams and doctors due to the disaster [4].

The economic implications are another of the potential benefits of setting up the Centre as it will stimulate economic growth by promoting research, innovation and technology transfer in disaster management, forensic science and biometric sectors. This will create new job opportunities, attract investment and guide economic development in the regions where the Centre operates. The achievement of the ambitious goals of the CDFBS will depend on the collaboration of a wide range of stakeholders who share a common commitment to global security and well-being. This issue calls into question humanitarian logistics, on which the efficiency of relief operations depends to a large extent, in particular the key roles of stakeholders in the effective management of an MD. Hence the need to develop solid logistical systems, as part of a humanitarian action that assigns to each of the actors involved defined tasks in the supply chain of humanitarian aid.

In this context, a precise and consistent commitment on the part of government agencies is required. National governments will play a key role in providing financial support, policy direction and regulatory frameworks essential to the Centre's operations. Their continued commitment is not only a testament to their dedication to the well-being of their citizens, but also crucial to the long-term sustainability of the Centre. Moreover, local governments carry out the most active tasks during the MD. We must not forget that it is the responsibility of government agencies to protect the community from vulnerability and reduce the impact of disasters, including by supporting structures that share a common commitment to global security and well-being. Partnerships with influential organisations such as the United Nations, INTERPOL, the World Health Organization and the International Criminal Police Organization will be key to extending the Centre's global reach and strengthening its credibility. These collaborations will facilitate the dissemination of best practices and the alignment of international efforts. Among the virtuous activities stands out the DVI for the recovery and dignified identification of human remains, so as to allow their return to the next of kin waiting. Collaborations with universities, research institutes and respected academic experts will enrich the Centre's research efforts, training programmes and the dissemination of knowledge.

These partnerships will contribute to the academic rigour and scientific excellence underpinning CDFBS operations [5].

The private sector will also be called upon to contribute. Engagement with technology companies, biometric solution providers, disaster management companies, and forensic labs will accelerate innovation and adoption of advanced technologies even in forensics. For about two years, a model of relief chains composed of humanitarian organisations and third-party logistics service providers have been studied by Shrokh and colleagues (2021) with encouraging results. Last but not least, partnerships with NGOs specialised in disaster response, humanitarian aid and defence will improve the Centre's capacity to address the global needs of affected communities and promote social inclusivity. These collaborations will ensure a holistic approach to disaster and recovery, in line with the current trend towards the Collaborative Humanitarian Relief Chain (CHRC) model, a system composed of several Humanitarian Organisations designed to make the necessary decisions on how to supply relief goods, pre-positioned and distributed before and after the disaster.

The CDFBS's ability to achieve its mission and objectives depends on a robust operational framework meticulously designed to optimise efficiency and impact. It must be said that in the definition of community resilience the specificity of the place and the social, historical and political contexts are taken into account, as it is recognized that resilience is not a characteristic inherent to individuals or the community but is culturally informed and defined. This is a challenge that the Center will have to consider when planning its next activities. Precisely from this perspective, the Center aims to involve the public, also through raising awareness of its activities and involving local communities in disaster preparedness and response efforts [6]. Numerous studies have shown that participation in community pre-disaster management committees by social organisations and private citizens significantly contributes to the development of management capacity and resilience in the event of critical events.

Adequate physical infrastructure is essential to achieving the Centre's objectives. To facilitate cutting-edge research, training and knowledge dissemination, the Center will need state-of-the-art facilities. These will include laboratories, research spaces, training rooms and a dedicated Data Center for information management and security. The importance of cloud services provided by data centre networks in terms of disaster protection has long been documented in the scientific literature. Cloud services require a substrate network with high capacity, low latency, high availability, and low cost. Such a complex system will be appropriately subjected to adequate governance and management. A board of directors, composed of representatives of governments, international organisations and stakeholders, will oversee the Centre's activities. This council will be tasked with formulating policies, ensuring effective management, and providing strategic guidance to the CDFBS. In line with the holistic philosophy of the CDFBS, any future paradigm and policy direction must be inspired by inclusive emergency management. The "Comprehensive Vulnerability Management" model, proposed by McEntire and colleagues (2002) and subsequent developments, may prove to be the most suitable to guide the efforts of scholars and practitioners to understand and reduce MD. The Center could represent a valid forum for combining the vision of scholars in favour of a global and

coherent approach to disaster reduction with that of professionals who seem to continually find themselves faced with dynamic and apparently contradictory objectives and strategies.

Research and Innovation will be the key words that inspire the Centre's activities. The CDFBS will establish dedicated research clusters focusing on disaster management, forensics and biometric technologies. These clusters will serve as fertile ground for interdisciplinary collaborations and technological advancements, driving significant advances in these critical fields. The Centre's future activities could be framed within the "H2020 ESPREssO" (Enhancing Synergies for Disaster Prevention in the European Union) project, with the aim of highlighting existing gaps and priorities for Research and Innovation (R&I) in the field of natural hazards, disaster risk reduction, management and adaptation to climate change. The research priorities fall under the Sendai Framework for Disaster Risk Reduction 2015-2030 (SFDRR) and the related EU Action Plan, which identifies five broad areas of research and innovation in the field of disaster risk reduction, where investments are needed, including improving risk assessment and data quality, risk governance, partnerships and human behaviour [7].

About capacity building, comprehensive training programmes tailored to the specific needs of various stakeholders, including disaster management professionals, forensic investigators, law enforcement agencies and biometric specialists, will be a cornerstone of the CDFBS offering. These programmes will be taught by renowned experts in their respective fields. Recent studies on responding to MDs have confirmed that simulation exercises and repeated training are important factors in ensuring better preparedness and resilience in the event of an incident. Effective preparedness requires a well-planned and integrated effort by all professionals involved, who must be equipped with specific emergency knowledge and skills. With this in mind, it may be necessary to develop a systematic method for regular monitoring and follow-up of how emergency plans are implemented by emergency facility personnel. The CDFBS will promote partnerships, knowledge exchange programmes and collaborative projects between stakeholders to promote global cooperation. Regular meetings, conferences and joint research initiatives will ensure that the centre remains a vibrant centre for international networking. Decision-making in complex contexts demands collaborative approaches to knowledge production, involving agencies, critical infrastructure organisations and academic experts. Research findings on this topic show that the professionals involved, from different contexts, have specific knowledge needs, related to different stages of decision-making and with different purposes, but all equally important for risk management, generating the 'co creation' model proposed by Barton and colleagues (2020).

The Center will establish a comprehensive information management system that includes a resource repository, database and a user-friendly web platform for knowledge dissemination. This digital infrastructure will enable global access to invaluable information and research results, overcoming geographical barriers. Emerging work focusing on the social drivers of disaster resilience demonstrates how digital capabilities help improve drivers such as social capital, community competence, economic development, information and communication. Therefore, facilitated access and optimal use of digital technologies for disaster

resilience is imperative, now more than ever. The factor of cultural sensitivity is not at all unrelated to this discourse, which calls into question the skills and mindset of the disaster-stricken population. Results of field research indicate a significant difference between cultures in perceived risk levels that do not match actual exposure rates. These findings suggest that cultural factors may have a greater influence on risk perception than social exposure, and the belief that we are more immune to disasters than others can be an intercultural phenomenon. The anthropology of disasters believes (correctly, of course) that policies and practices related to critical events must consider local culture, which is often seen as a tangible, homogeneous, static entity. Field experiences have shown, on the contrary, how culture is fluid, evolving and intertwined with a series of economic, political, and social relationships and tensions that constantly alter seemingly stable processes. Over the last few decades, research into disasters, particularly the reasons behind the success or otherwise of recovery operations, has revealed the importance of incorporating the key element of a people's culture into critical event management. The Centre's challenge will therefore be to develop more useful and successful prescriptions to incorporate cultural sensitivity into MD policy and practice.

3. Ethical and humanitarian issues

Ethics are the foundation on which societies are built and are fundamental to political, social and economic decision-making. The Center counts respect for the human person in all its forms among its highest values. The concepts of caring relationships, moral citizenship, and code of ethics also contribute to the construction of the ethical framework of CDFBS. This means that the Center will have to adopt an ethically oriented perspective respectful of a series of principles: first and foremost, all the Center's activities must provide adequate responses to the needs of elderly individuals, children, low-income people and other vulnerable populations [8].

The combination of a mass casualty situation with the use of sensitive disciplines such as forensic and biometric sciences entail specific ethical challenges, which will have to inspire the principles governing the Centre's tasks [9]. In hindsight, it is research in disaster contexts that poses unique ethical dilemmas [10], imposing a reasonable balance between the critical issues of the research and the protection of the psycho-physical wellbeing of its participants. Priority in disasters should be given to the safety of disaster-affected people and rescuers, including rescue and body recovery operations. Furthermore, during and after an MD, ethical questions arise regarding the appropriate and equitable allocation of relief funds to aid recovery. In any event, scarce resources should be allocated fairly. In addition to this, the humanitarian and legal responsibility for disaster victims' identification falls on the forensic community.

As per procedures on samples arising from MDs, it is imperative that activities on human remains do not compromise the dignity, autonomy, and rights of casualties and their close relatives [11], during both the primary and secondary phases of the research [12]. Actually, each mass disaster has peculiarities that require a specific approach: therefore, the collection and preservation of forensic evidence should be considered part of the field response procedure. Although the goal is to achieve identification, the specific context of each application of DVI procedures has its own specific problems, ranging from the technical approach to

ethical issues. From this point of view, we welcome the comments from CIOMS (2006): "[t]he ethical justification of biomedical research involving human subjects is the prospect of discovering new ways of benefiting people's health. Such research can be ethically justifiable only if it is carried out in ways that respect and protect, and are fair to, the subjects of that research and are morally acceptable within the communities in which the research is carried out […]". With specific reference to MDs, three main ethical aspects may be detected, namely the humanitarian importance of identification; the allocation of resources in identifying victims; and secondary research use of samples initially collected for identification purposes. An issue unique to MDs' casualties and their relatives is privacy and confidentiality. The names of victims and relatives may be disclosed by the media or others; this should not happen although true confidentiality cannot really be guaranteed. Another crucial issue is to inform the public, mainly the families of the victims, so that they can stop searching for their relatives. This requires the use of specific communication strategies as well as a high degree of empathy by the research staff, which must be learned and developed during special training activities organised by the CDFBS.

The CDFBS's sustainability and continued impact will be underpinned by a multifaceted funding model. It will rely on a combination of government funding, private sector investments, and grants from international organisations. This diversified approach to funding will ensure the Center's ability to weather challenges and adapt to evolving global circumstances. As numerous studies indicate that agencies during disaster are also vulnerable and may well be stretched beyond their own capacity to respond adequately to community requirements, an adequate Monitoring and Evaluation (M&E) framework will need to be outlined to measure the Center impact, effectiveness and achievement of its objectives. To this end, a theoretical framework will be developed which, drawing on the literature on improving the quality of response to MDs, includes a three-phase M&E cycle (i.e., document and evaluate, disseminate and implement) that must be completed sequentially to learn from past experiences and improve future disaster response efforts.

4. Conclusion

Disaster management has become an imperative, in a global context of climate change, political and religious conflicts, terrorism and migration phenomena. Globally, there are numerous accidents and disasters that have a negative impact on people's lives and health, as well as economic losses, psychological suffering, and disruption of public life. The frequency of natural hazards has formidably increased since the 2000s, posing not only great challenges to the disaster prevention and mitigation capacity of infrastructure, but also present important demands on the rescue and recovery response.

The vision of the International "Center for Disasters, Forensic, and Biometric Sciences" is a testament to humanity's collective commitment to safeguarding lives, preserving security, and advancing knowledge. By establishing the CDFBS and nurturing it into a thriving institution, we embark on a journey that transcends borders and cultures, uniting diverse stakeholders under a common banner of resilience, innovation, and global cooperation. In doing so, we equip ourselves to confront the challenges of an ever-changing world and lay the foundation for a safer, and more

secure future for all. Emphasising a multidisciplinary approach, the Center seeks to maximise the expertise, advice, and available resources from various agencies involved in management of mass casualties. By promoting international collaboration and leveraging scientific advancements, the "Center for Disaster, Forensic, and Biometric Sciences" aspires to enhance disaster response capabilities, streamline victim identification processes, and ultimately contribute to the efficient and compassionate management of mass casualty incidents on a global scale.

Notes.

(1). Monitoring and mapping, remote sensing techniques, robotics & drone technology, ML, geospatial analysis, telecommunications and network services, incident and hotspot analysis, smart city & transport planning, environmental impact analysis - just to mention the main Innovative Technologies (Abid, Sulaiman., Chan, et al., 2021).
(2). Several years ago, INTERPOL imposed the recommendation that member countries should have a team of DVI specialists at their disposal to be able to assist the on-site teams with the identification of their own respective national subjects. Thereafter, most INTERPOL member countries have recognized the necessity and advantages and have founded their own DVI Teams.
(3). A stimulating area of research could be that of advanced sensor-based systems, primarily wireless sensor networks and IoT, promising tools for the early diagnosis of disasters, as well as for the detection and location of survivors. Another search field could be that of Device-to-Device (D2D) communication systems as a basis for cellular networks, capable of increasing system performance enabling public safety services. A key requirement for these services is indeed to provide alternative access to cellular networks when they are partially or completely damaged due to a natural or man-made disaster event.
(4). According to CRED – Centre for Research on the Epidemiology of Disasters (2018), between 1998 and 2017, 1.3 million people died, and 4.4 billion people were injured or homeless due to natural disasters. Historical data show a significant increase in the number and severity of disasters worldwide, including due to man-made events such as terrorist attacks.
(5). Academic interest in the critical events of multiple victims is demonstrated by the wide range of publications on the subject. In fact, there are around 80 English-language magazines today that deal mainly with disaster risk reduction (DRR) and related fields.
(6). The CDFBS should be inspired by UNESCO's 2005 Universal Declaration on Bioethics and Human Rights, which states that "[p]ersons and professionals concerned, and society as a whole should be engaged in dialogue on a regular basis," and "[o]opportunities for informed pluralistic public debate, seeking the expression of all relevant opinions, should be promoted".
(7). These areas emerged from the shortcomings reported by the stakeholders and international experts involved in the project.
(8). Studies on the topic have shown that pre-disaster training considering ethical considerations can improve the post-disaster ability of staff and volunteers to function adequately during increased service demands, strengthening organisational strategies and resilience.
(9). Beatley (1989, p. 7) noted: "The appropriateness of particular public policy responses to disasters will depend upon the specific criteria or principles or standards one feels society ought to acknowledge and embrace. Moral philosophy offers several primary alternative ethical vantage points to guide planners and policymakers in the mitigation of disasters".
(10). Richman (1997, p. 374) stated: "We always need to be aware of the ethical implications of our work, but when dealing with people in extreme situations we are obligated to give special thought to ethical issues".
(11). The issue, which involves the identification procedures of human remains (e.g., fingerprinting, DNA analysis, and other biometric techniques) is very complex and debated on an international level, due to the different legislative framework adopted by the various countries.
(12). By primary phase we mean that one relating to the identification procedures of human remains while the secondary phase concerns the conservation of the biological samples used in the primary phase. It should also be considered that, to complete successfully DVI procedures, it may be necessary to collect samples from the victim's close relatives.

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