Commentary

The Limitations and Challenges of Researching Mass Casualty Incidents and Disasters in Europe

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Europe's multi-hazard environment underscores the urgency of establishing a standard system for data collection and sharing during mass casualty incidents and disasters. Variations in MCI definitions and data sets hinder cross-border comparability and timely exchange of critical information. Tailored data methods, well-organized command structures, and interoperable technologies are crucial to reduce delays in patient care and resource allocation. Recent initiatives demonstrate that standardized triage tags, AI-driven decision-making support, and integrated real-time platforms improve situational awareness and coordination across emergency services. Nevertheless, significant disparities persist due to fragmented practices and budget constraints, especially at subnational levels. Policy measures must address these challenges by setting minimum data standards, harmonizing national and regional frameworks, and promoting the adoption of communication tools such as drones and geographic information systems. Ethical considerations remain paramount, necessitating responsible data handling that respects privacy regulations and ensures equitable treatment of patients. Public–private partnerships have proven instrumental in deploying innovative technologies, while shared platforms bolster interoperability among diverse stakeholders. Sustaining these efforts demands adequate funding, continued research, and training programs in emergency data management for all responders. When scaled and standardized across the continent, evidence-based approaches to MCI data collection and sharing can reshape disaster response into a more efficient, unified, and equitable system. This transformation will strengthen Europe's resilience against a continually evolving array of natural and man-made hazards, ultimately improving outcomes for communities at risk.

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Introduction

A Mass Casualty Incident (MCI) is an event where the number of victims exceeds local resources, requiring exceptional emergency arrangements and additional assistance. The World Health Organization defines MCI as "disasters and major incidents characterized by quantity, severity, and diversity of patients that can rapidly overwhelm the ability of local medical resources to deliver comprehensive and definitive medical care."[1] Research in MCI poses unique difficulties for several reasons; the first one is the absence of a generally accepted definition of the phenomenon, which is particularly difficult to do in its quantitative dimension due to the absence of a unanimous agreement on the minimum number of victims to consider an incident as an MCI. In an MCI, victims from diverse hazards often overwhelm health care services [2]. However, the importance and impact of MCI depend significantly on the context and capacity of the national and regional healthcare system and additional resources, such as the number of on-call teams where it occurs. The second important reason an MCI is challenging to investigate is the absence of an agreement on the essential data to collect from the incident. This lack of agreement on the essential data needed to analyze the MCI episodes is difficult and significantly limits the comparability of the results of researchers from different countries and contexts. Mass casualty incidents and disasters, whether natural or man-made, demand robust data collection before, during, and after the event. Effective data practices can save lives and improve coordination in Europe's multi-hazard context[3]. In this perspective review, we explore best practices for data collection, standardization strategies, technology tools, and policy recommendations, focusing on European frameworks and experiences.

Best Practices for Data Collection and Coordination in MCIs Varied Methods by Incident Type

Data collection methods must be tailored to the nature of the MCI. Natural disasters (e.g., earthquakes, floods) often cover large areas and use geospatial data (satellite imagery, GIS maps) and crowdsourced information for situational awareness [4]. Terrorist attacks or mass shootings require rapid on-site triage data and real-time intelligence from law enforcement (e.g., identifying perpetrators and secondary threats) alongside medical data on victims[5]. Despite these differences, a common principle is to capture essential information quickly – such as the *number of casualties, severity of injuries, resource needs, and situational hazards* – and relay it to all responders.

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Gathering accurate data in real-time during an unfolding disaster is challenging. MCIs are chaotic; communications infrastructure may be damaged or overloaded, and information can be incomplete or rapidly changing. Responders often face “fog of war” conditions with fragmented situational data[6]. One key challenge is the lack of a unified platform – different teams might log information on separate systems or paper, slowing the aggregate situational awareness. Another challenge is ensuring connectivity: if cellular networks fail (common in disasters), responders need backup radios or satellite links to transmit data[7]. Improving real-time data collection requires advanced planning and tools. Best practices include using standardized triage tags or mobile apps to record patient data at the scene, which can then be scanned or synced to a central system[8]. Training personnel to use these tools under pressure is essential. Establishing ad hoc networks at the disaster site can improve data transmission; for instance, the IDIRA project deployed portable broadband communication units to affected regions to support real-time information sharing[9]. Another tactic is simplifying data inputs – using checklists or tick-box forms (digital or paper) that can be quickly filled by responders and later digitized. A well-organized chain of command is critical: studies note that an effective command-and-control structure speeds up data reporting and resource deployment, directly impacting survival[10].

High-level coordination and data sharing between emergency medical services (EMS), fire, police, hospitals, and government agencies is crucial in MCIs[11]. For instance, establishing a unified incident command system (or similar coordination structure) allows data to flow into a common operational picture accessible by all stakeholders[12]. The EU-funded IDIRA project demonstrated that providing a shared operational picture and exchanging incident information in a standardized way improved multi-agency coordination while also enabling standardized triage tags to be used at the scene[9]. Multi-agency drills in Europe indicate room for improvement – in one study, only 44% of hospitals had conducted recent MCI exercises[13], underscoring the gap in the need for more integrated training.

Interoperability in Data Sharing in MCIs and Disasters

Interoperability is defined as the ability of different organizations' systems to exchange and use information. Interoperability is a cornerstone of effective MCI response[14]. Lack of interoperability leads to siloed data and delays. In Europe, MCIs often involve cross-border or multi-jurisdictional cooperation, making interoperability even more vital[15]. Data standards and protocols play a big role here. Using common alerting and information exchange formats (such as the Common Alerting Protocol [CAP] or the

EDXL suite for emergency data exchange) enables disparate systems to "speak" to each other[16]. Interoperability also means aligning terminology, for example, using common definitions for casualty status or resource types. Several European countries have developed national interoperability frameworks – for example, France's cadre d'interopérabilité des situations d'urgence (CISU) protocol[17] and Germany's Universal Control Room Interface (UCRI)[18]. In practice, the EU-funded IDIRA project integrated legacy command systems with standard data formats (EDXL-RM for resource messages, EDXL-SitRep for situation reports, etc.), overcoming language barriers and technical gaps between different countries' systems[9]. The lesson learned is that responders should invest in interoperable tools and agree on data schemas before a disaster strikes[19]. This includes cross-border agreements in the EU context so that, for instance, a French team's incident report can be readily understood by a Spanish or German team. Interoperability extends beyond technology to procedures[20] – aligning protocols like triage categories or radio codes across regions enhances the effective sharing of information during MCIs.

Standardization Strategies for MCI Data- Current Gaps in Europe's Standardization

Across Europe, there are significant gaps and inconsistencies in how MCI data is collected and reported[21]. Different countries, even different regions or agencies within the same country – often use their own formats and terminologies for MCIs[1][22]. For example, one region's ambulance service might record patient information differently than a neighboring region's service, complicating data aggregation. A recent study on cross-border MCIs highlighted that important differences exist not only between countries but also between regions within the same country[10]. These disparities can lead to delays or errors when multiple agencies work together. One concrete gap is the lack of a unified minimum data set for MCIs across Europe – currently, what data gets collected (and how) can vary widely. For instance, Norway has no national standard for hospital triage in disasters and no systematic way to follow up on hospital preparedness data for MCIs[13]. Such gaps mean that each hospital or EMS might use its own triage tags and criteria, making it hard to merge data in a large incident. Moreover, the multi-language environment in Europe adds complexity: incident report forms need translating if not standardized. Overall, Europe's "data landscape" for MCIs is fragmented, which hinders efficient mutual assistance in disasters.

Experts and organizations have called for common frameworks to address these gaps[23]. One proposed solution is developing a Minimum Data Set (MDS) for MCIs that could be adopted Europe-wide[24]. The EU-funded VALKYRIES project worked on harmonized procedures and an MDS for cross-border MCIs so that essential information is collected in a consistent way and communicated in real time during large exercises[25]. International examples also exist: the Incident Command System (ICS) and National Incident Management System (NIMS) used in the United States provide a standardized, all-hazard framework for managing incidents[26]. These systems include standard forms and terminology for incident data (e.g., situation reports, resource requests) and have proven effective in multi-agency response[9]. Another example is the World Health Organization's Emergency Medical Teams (EMT) initiative, which employs standardized data reporting for field hospitals responding to disasters[27]. Europe can draw on these models. Indeed, initiatives such as the NIGHTINGALE project (which coordinates first responder skills and tools for MCIs) and specific EU Civil Protection Mechanism plans are steps toward more standardized approaches across Europe[21].

Role of the EU and National Governments

The European Union can be pivotal in driving uniform data collection protocols. Through the EU Civil Protection Mechanism, the EU already encourages member states to develop "higher common standards" and interoperable practices so that teams from different countries can work interchangeably[9]. EU institutions such as the Directorate-General for European Civil Protection and Humanitarian Aid Operations (DG ECHO)[28] and the Emergency Response Coordination Centre[29] could issue guidelines or templates for MCI data reporting that member states incorporate into their national disaster plans. There is precedent for EU-wide standardization: for example, the EU's Electronic Communications Code mandated all member states to implement handset-derived caller location for emergencies by 2020[30], a policy that effectively standardized how location data is collected from emergency calls.

Similarly, the EU could mandate or incentivize a standard MCI reporting format. National governments should integrate these standards into their emergency protocols and ensure that all relevant agencies (EMS, police, hospitals, etc.) are trained on them. Some countries have already begun this; for instance, France's CISU emergency interoperability framework uses standardized data schemas (based on EDXL) to allow sharing of qualified emergency data among responders[17]. Governments can also invest in

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national systems (such as incident management software) compatible with European standards. Importantly, cross-border collaborations (exercises, joint task forces) backed by governments help reinforce standard protocols. The EU's support for projects like Search & Rescue [31], which built a common platform for various disaster scenarios – is another way standards can be tested and refined in practice. In summary, the EU can set the vision and provide the tools while national authorities adopt and implement uniform data collection practices in their jurisdictions.

Ethical and Legal Considerations

Standardizing data collection must be done with respect for privacy, ethics, and legal norms[32]. MCIs often involve personal and sensitive information (names of victims, health status, etc.), so any system must comply with data protection laws such as the General Data Protection Regulation (GDPR). Data protection regulations do allow information sharing in emergencies. For example, GDPR provisions and guidance from regulators make clear that sharing personal data to save lives is lawful in urgent situations[33]. However, this does not mean a free-for-all with data. Ethical best practice is to collect only what is necessary for the response and to ensure that data is handled securely. International privacy guidelines emphasize that any emergency measures which limit normal data protection must be justified and proportional to the crisis, have appropriate safeguards, and last only as long as the emergency persists[34]. This means responders might temporarily bypass some usual privacy steps (for instance, accessing medical records without consent) if it is critical, but such measures should not become permanent. Maintaining the dignity and privacy of victims is paramount. For example, data about deceased or injured individuals should be shared on a need-to-know basis and protected from public exposure. Another legal aspect is data ownership and liability: agencies need clear policies on who "owns" the collected data and how it can be used post-incident (for investigation, lessons learned, etc.) in a way that respects individual rights. Additionally, standardized data must consider consent and transparency; whenever possible, individuals (or their families) should be informed about how their data (such as identity or medical status) is being used in incident management. Finally, standardization should incorporate ethics in design. For example, triage algorithms or AI tools used in MCIs should be audited for fairness and bias to ensure that no group is inadvertently disadvantaged. In Europe, initiatives to review the ethical use of AI in public safety, along with frameworks such as the GDPR, provide a strong backdrop to ensure that as data practices are standardized, they are implemented responsibly[35].

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Modern Technologies and Tools for Data Collection in MCIs

A range of technologies is now available to collect and manage data during mass casualty events, greatly enhancing situational awareness[36]. Geographic Information Systems (GIS) and mapping tools are fundamental in natural disasters and large-scale incidents – they provide real-time visualizations of the affected area, resources, and hazard zones. For example, the city of Matosinhos in Portugal (facing wildfire, flood, and industrial risks) uses a GIS-based dashboard so that all response teams share the same real-time map and information updates[4]. Such common map interfaces (often displayed in command centers and on mobile devices) help responders plot victim locations, evacuation routes, and resource deployments on the fly.

Drones (unmanned aerial systems) have rapidly become invaluable in MCIs as well[37]. They can provide aerial imagery for damage assessment, search for survivors in hard-to-reach areas, and even deliver medical supplies. European responders have used drones for tasks ranging from surveying wildfire perimeters to scanning buildings after terrorist attacks[38]. Innovative uses include employing drones equipped with sensors to detect hazardous gases or to remotely neutralize dangers. For example, a recent trial showed drones assisting in safely puncturing gas cylinders during a fire[38].

Mobile applications and smartphone-based tools are also prominent[39]. These include apps for first responders to report triage data, apps for citizens to send incident reports or to receive instructions, and tools to manage volunteers. In the EU's Search and Rescue project, developers created smartphone apps to optimize volunteer management – registering volunteers and assigning them to tasks during crises[40]. Other mobile technology examples are automated text systems that allow victims to send their GPS location or status to emergency services[41].

Real-time data platforms tie all this together: integrated software systems (often cloud-based) compile data streams – emergency calls, responder reports, social media feeds, sensor data, and GIS layers – into a single dashboard[42]. The Search and Rescue project built one such platform that consolidated live incident data, communications, maps, resource tracking, and even triage information, exemplifying how technology can actively assist commanders[40]. Additionally, the EU's Copernicus Emergency Management Service provides satellite mapping and analysis within hours of a disaster, offering a critical data source for large incidents[43]. In summary, today's MCIs in Europe leverage a mix of GIS for spatial

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awareness, drones for rapid reconnaissance, mobile apps for field data entry, and centralized platforms for a real-time operational picture.

AI and Machine Learning in MCIs

Artificial intelligence (AI) is increasingly explored to enhance MCI data handling and decision support[44]. AI and machine learning can quickly analyze large volumes of data that would otherwise overwhelm human operators[45]. One application is in emergency call centers: pilot projects in Europe are using AI to transcribe calls, detect the caller's language and emotions, and even prioritize incidents based on keywords or ambient sounds such as identifying panicked tones or gunshots in the background[46]. AI is also employed in situational analysis; for instance, the European Commission's Joint Research Centre developed an algorithm to scan millions of social media posts and images in real time during disasters, helping to identify affected areas and assess damage[47]. This approach was first used to assist relief efforts after a major earthquake, where AI sifted social media data to provide situational awareness that complemented satellite and official reports.

Machine learning models can also predict how an incident might evolve – for example, forecasting patient surges to hospitals or the spread of a fire based on weather and terrain data[48]. In flood[49] and earthquake[50] scenarios, AI can rapidly map damage severity by analyzing imagery, guiding rescue teams to the hardest-hit zones faster. Additionally, decision-support systems powered by AI are under testing to suggest optimal resource allocation (e.g., recommending where to send extra ambulances based on incoming data patterns)[51]. Explorations of AI in triage – such as using computer vision to assess injuries from photos or sensors to advise medics on patient prioritization – are in early stages and raise ethical questions[52]. Overall, Europe recognizes AI's potential in crisis management, and initiatives such as the European Crisis Management Laboratory are working on incorporating AI (including large language models and data mining) to improve emergency situational awareness[46]. It is important to note that while AI can greatly augment human decision-making, it must be used carefully; algorithms need to be transparent and validated so that emergency managers trust the recommendations[53]. The goal is for AI to manage information overload and deliver actionable insights in MCIs, ultimately making response faster and more effective.

Case Studies of Successful Implementation in EU

Recent European projects and real-world responses provide examples of technology-enabled data collection success. The Search and Rescue project (EU H2020, involving multiple EU countries) is a standout example of a comprehensive technological solution[54]. It advanced numerous tools (from drones to wearables) and integrated them via a common platform tested in field exercises across different disaster types[31]. In simulated earthquake, flood, and wildfire scenarios, the platform demonstrated the ability to monitor the response in real time, consolidate field and headquarters data, and allocate resources efficiently. First responders were equipped with smart uniforms containing wearable sensors that transmitted their vital signs and environmental readings (e.g., gas levels, radiation) back to commanders continuously. This not only helped track the health and safety of responders but also fed into incident data (for example, detecting a spike in CO levels could indicate a new hazard). The platform's capability to integrate maps, unit locations, victim triage statuses, and logistics (personnel, vehicles, supplies) onto one screen dramatically improved the situational overview available to decision-makers[55]. Feedback from these exercises was positive, with the common platform helping different agencies work in sync.

Another example comes from a cross-border exercise under the VALKYRIES project[56], where multiple countries used a unified data set and interoperable platform. In that drill, all casualty information and resource data were input into a shared system and transmitted in real time to each nation's command center, demonstrating smooth data exchange despite language differences. Beyond projects, cities are implementing technology in live responses: as mentioned, Matosinhos in Portugal employed GIS dashboards during local emergencies to coordinate fire, medical, and police units on a common interface[4].

In another instance, during the 2017 wildfires in Portugal and Spain, authorities used Copernicus satellite maps combined with drone reconnaissance to pinpoint villages at risk and direct evacuations – a de facto use of multi-source data integration[57]. Moreover, European emergency services are adopting Advanced Mobile Location (AML) and other caller location technologies in daily operations[58]; these have led to tangible life-saving outcomes when, for example, injured individuals or terror attack victims have been quickly located via automated GPS data from their phones. Each of these cases underscores that when modern tools are properly integrated into emergency workflows, they significantly enhance data collection and sharing, leading to better-coordinated and more effective responses.

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Challenges in MCIs Technology Adoption and Solutions

While the benefits of these technologies are clear, adopting them is not without challenges[59]. One major hurdle is training and human factors[60]. Introducing new data systems or devices requires training responders and ensuring they trust and know how to use them under pressure. In EU, responders come from varied agencies and countries, so consistent training programs and user-friendly design are vital. Another challenge is resource and infrastructure constraints[61]: not all regions or agencies have the budget to procure high-end systems or maintain them. Ensuring robust IT infrastructure (servers, network connectivity) that can withstand disaster conditions is a nontrivial task. Interoperability issues can also impede technology adoption – if one agency's tool is not compatible with another's, it can create data silos. Hence the push for standards mentioned earlier. Regulatory hurdles may exist as well; for example, drone usage can be limited by airspace rules, and data-sharing platforms might face legal barriers between jurisdictions[62]. The COLLARIS project noted practical issues such as a shortage of certified drone pilots and restrictive rules on beyond-visual-line-of-sight operations[38].

Solutions include capacity building such as investing in regular exercises and training, phased implementation includes rolling out tools in stages and gathering user feedback, and securing political and financial support. EU funding mechanisms (e.g., Horizon Europe, Digital Europe, or the Civil Protection Knowledge Network) can help subsidize modernizing emergency data systems across member states, reducing disparities. Public–private partnerships can also alleviate cost and development burdens[63]. Finally, continuous improvement should be built into the system: after every major incident or exercise, lessons learned about technology use need to feed back into software updates or protocol changes. In summary, adopting advanced tools for MCI data is as much about people and policies as it is about technology. With adequate training, supportive leadership, and iterative refinement, these challenges can be managed, paving the way for widespread use of life-saving technologies.

Policy Recommendations for Improved MCI Data Collection and Management

Policymakers at the EU and national levels should prioritize data management in emergency preparedness align with UNDRR data strategy and roadmap 2023-2027[64]. One recommendation is to establish mandatory minimum data standards for MCIs[24]. Just as reporting formats exist for routine public health or security data, an official "MCI data protocol" could be adopted. This might involve an EU directive or an internationally agreed guideline that defines what information must be collected and in what format, and how it should be shared. Such a policy would push agencies to align data practices before an incident occurs. Additionally, policies should require regular multi-agency training and drills focused on data sharing. Governments can set targets, for example, each region must conduct a yearly exercise testing data interoperability between EMS, police, and hospitals. Tied to this, creating a culture of post-incident reporting and learning is crucial: policies can mandate that after any large incident, a review is done to evaluate data handling. These after-action reports should be shared nationally or EU-wide to disseminate best practices.

Another policy idea is to integrate MCI data readiness into accreditation or funding criteria – for instance, hospitals or EMS units could be required to have digital incident reporting tools as a condition of certain funding, ensuring baseline capabilities. The EU Civil Protection Mechanism already emphasizes coordinated response[29]; policy enhancements here could include developing a European "incident management handbook" that codifies data collection procedures for cross-border deployments using the same data language. The EU might also facilitate a common digital platform or network for crisis data, building on existing systems into which countries can plug during major disasters. Overall, forward-looking policies should treat data as equally important as equipment or personnel in disaster response.

EU-Level and National Multi-Hazard Response Strategies

Europe should continue moving toward an all-hazard, multi-hazard approach in its disaster preparedness and response frameworks[65]. At the EU level, this means ensuring that initiatives like the EU Disaster Risk Reduction strategies and the Union Civil Protection Mechanism explicitly account for multi-hazard scenarios – situations where different types of incidents occur together or cascade[66]. Strategies must encourage flexibility: responders should be trained and equipped to handle a range of emergencies using common principles. The Sendai Framework for Disaster Risk Reduction highlights the importance of understanding risk and enhancing disaster preparedness; implementing Sendai in Europe includes improving data interoperability and early warning across hazards. Concretely, an EU-level strategy could develop a unified crisis information management system usable in any emergency, whether a terror attack or a flood – ensuring a consistent approach.

National strategies should mirror this; many European countries now have "all-hazard plans." Governments should refine these plans to ensure they include triggers for data sharing across sectors. For example, a national plan might stipulate that in any MCI, a central operations center is activated to compile data from all stakeholders such as health services, police, and provide one unified situation report. Multi-hazard strategy also means involving nontraditional actors such as meteorological services, cybersecurity teams, or military units – since some events may require their data inputs as well. The EU's integrated approach to security and crisis response should be further developed, breaking down silos between areas such as counterterrorism, civil protection, and public health. A key recommendation is to utilize platforms like the EU Civil Protection Knowledge Network to disseminate multi-hazard guidelines and train emergency managers in data-driven responses across all incident types[67]. Aligning EU and national strategies in this way ensures that whether the incident is a flood, an earthquake, or an attack, the response framework remains robust and unified.

Funding and Investment in MCIs Research & Technology

Improving data collection in MCIs requires sustained investment. The EU and national governments should allocate dedicated funding for MCIs technology and research. This can be achieved through existing instruments like the Horizon Europe research program or through targeted funds under the Civil Protection Mechanism. For instance, funding calls could solicit projects to develop open-source disaster data platforms or AI tools customized for European emergency services. Past and ongoing projects such as IDIRA, VALKYRIES, Search & Rescue, NIGHTINGALE, and recently PREPSHIELD[68] show that EU research funding can drive innovation and collaboration. Investment should also focus on implementation – grants for countries or regions to acquire and localize proven systems can help ensure that no member state is left behind technologically.

The EU could create a modernization fund for emergency services, helping less-resourced member states upgrade their data collection hardware and software. Another area for investment is training and human capital: funding pan-European training programs or exchanges, perhaps via the Civil Protection Knowledge Network, can raise skill levels in using new tools. Moreover, building testbeds and simulation centers where new technologies and protocols are tested in realistic disaster scenarios would be a smart investment to refine data practices. On the national side, governments should ensure that emergency services have budget lines for IT upgrades and data management personnel. Public–private partnerships can complement public funding with private innovation. Finally, investing in maintaining and scaling successful pilot systems is crucial – if a project demonstrates a great data solution in one region, there should be funding to roll it out broadly and sustain it long-term.

Public–Private Partnerships in Data Collection Efforts

Many of the technologies and platforms used in MCIs stem from private-sector innovations, such as mapping software, communication networks, AI algorithms, etc. Therefore, fostering public–private partnerships (PPPs) is key to improving data collection and management. One successful example in Europe is the implementation of Advanced Mobile Location (AML) for emergency calls[58]. This required coordination between government emergency numbers, mobile operating system developers, and telecom operators. The result was that when someone calls 112, their smartphone automatically sends precise GPS coordinates to dispatchers[58]. This PPP approach rapidly spread AML across Europe, greatly enhancing location data availability during MCIs.

Similarly, partnerships with mapping and satellite companies can provide responders with high-quality geographic data; for example, agreements with satellite operators may secure priority imagery of disaster zones. Social media companies and data providers are another crucial partner; establishing data-sharing agreements or APIs that allow emergency management centers to tap into real-time social media feeds with appropriate privacy safeguards can improve situational awareness[69]. The Joint Research Centre's social media analysis platform is one example of leveraging social media data during disasters[47]; formalizing such data access in emergencies would be beneficial. Tech companies can be invited into co-development programs – as seen in the AI pilot projects in several European emergency call centers[46]. Such collaborations allow emergency services to influence technology design to meet their needs while companies gain real-world testbeds.

PPPs can also address infrastructure. For instance, telecom firms working with governments to ensure mobile networks remain operational during crises through backup power or deployable cell towers, address critical data pipeline issues. To encourage PPPs, governments might provide incentives such as expedited regulatory approvals for new emergency technologies or cost-sharing for pilot programs. Involving insurance and industry groups may also be beneficial, as they have a stake in effective disaster mitigation. Clear frameworks on data responsibility in PPPs are necessary. For example, guidelines on how private partners handle citizen data during emergencies to ensure compliance and maintain public trust. In conclusion, by embracing PPPs, Europe can leverage cutting-edge private-sector innovation alongside the public sector's coordination capacity, accelerating the development and adoption of robust data collection systems for MCIs and ultimately building more resilient communities.

Conclusion

Europe's multi-hazard threat environment emphasizes the urgent need of robust data collection and sharing during mass casualty incidents. By adopting tailored data methods, strengthening coordination and interoperability, advancing standardization, deploying modern technologies such as geographic information systems and artificial intelligence, and shaping supportive policies with sufficient funding, European nations can greatly enhance their disaster response. Real-world projects and incidents have demonstrated what works, and the challenge now is to apply these lessons more broadly across the continent. A well-structured chain of command and efficient information flow, built on shared protocols and innovative tools, can yield lifesaving outcomes in the face of floods, earthquakes, or terror attacks. Through unified commitment at both EU and national levels, and with careful ethical oversight, Europe can transform crisis management in the coming years, ensuring faster, more intelligent, and more cohesive responses to mass casualty incidents.

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