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Information Harvesting and Integrating of Mass Casualty Incidents and Epidemic Outbreaks via Social Media

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ABSTRACT

In order to discern the condition of incidents, it is essential to collect accurate and timely disaster and epidemic information in a robust and reliable manner, particularly in a mass casualty incident (MCI). The concept of a Joint Professional Group (JPG) is proposed to enhance data accuracy and precision. In this case, the JPG comprises campus disaster experts distributed in all municipalities and counties of Taiwan. Since they have geographical advantages, they can promptly respond to and report disaster information in real-time. Amidst the vast amount of disaster information during an MCI, the information provided by the JPG can serve as the standard for chelating the truth on social media. Since decision-makers, emergency responders, and even stakeholders need to retrieve real-time, reliable, safe, and comprehensive information for patient rescuing and caring, the information sourced from the JPGs can be a benchmark for consolidating accurate data and filtering out misinformation. The JPGs will be a potential arbiter of the collected data by extracting reliable utilities from a cluttered information pool. Therefore, the collaboration between social media and JPGs will significantly boost the dissemination of disaster information in a robust, comprehensive, and real-time manner.

Keywords: Mass casualty incident; Joint Professional Group; Infodemic; Disaster information; COVID-19 information

1. BACKGROUND

A vast amount of disaster-related information will surge into social media in case of adverse events, yet retrieving accurate and beneficial information is like looking for a needle in a haystack. Since the end of 2019, the epidemic outbreak of coronavirus disease 2019 (COVID-19) has significantly impacted global health dramatically (WHO, 2020). Japan is an infected area in the early stage. Unfortunately, Japanese social media disseminated some unconfirmed, conjectural, and fake news regarding COVID-19. The information caused panic, racism, and anxiety in society, and impinged public communication as well as epidemic management (Asafo-Adjei et al., 2022; Shimizu, 2020). Another instance occurred in Lombardy, northern Italy, where a possible lockdown rumor was anticipated and reported by CNN before receiving official confirmation from the Italian Prime Minister (Cinelli et al., 2020). As a result, Lombardy residents flocked to train stations and airports to escape to southern regions before the implementation of the lockdown policy. This uncertain information affected the government's ability to contain the pandemic effectively. The term "infodemic" was coined to describe the risk of misinformation during epidemic outbreak management (Cinelli et al., 2020; Eysenbach, 2020; Zarocostas, 2020). Tedros Adhanom Ghebreyesus, the Director-General of the WHO, aptly stated, "We're not just fighting an epidemic; we're fighting an infodemic" (Zarocostas, 2020). This statement highlights the alarming spread of misinformation on social media platforms and other channels, posing a crucial challenge to public health. However, various strategies have been developed to address this infodemic (Biradar et al., 2022; Gisondi et al., 2022; Eysenbach, 2020; Pennycook et al., 2020; Zarocostas, 2020). Previous research has emphasized the importance of fact-checking, data proofreading, Internet gatekeeping, and peer-reviewing (Stapleton, 2003; Zucker, 2020). In this study, we propose the implementation of a professional-directed support group as a strategy to enhance data precision and accuracy during disasters. This approach aims to combat the infodemic and harness the potential of social media to its fullest extent.

To comprehend the nature of incidents, it is imperative to collect accurate and timely disaster and epidemic information in a robust and trustworthy manner, particularly in the context of mass casualty incidents (MCIs). The retrieval of disaster information relies on three primary requirements: accuracy, real-time availability, and abundance. In practice, during a catastrophic event, approximately 200-400 thousand pieces of data are gathered from the Internet and social media platforms. However, only a minuscule fraction, ranging from 1-2 thousandths, proves valuable in understanding the truth behind the occurrences (Lee, 2019). Consequently, the screening process for this vast amount of data poses a significant challenge for end-users seeking to utilize this invaluable resource. In an effort to enhance data precision and accuracy, this study proposes the concept of a Joint Professional Group (JPG).

In this case, the JPG consists of campus disaster experts

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dispersed across all municipalities and counties in Taiwan. Their strategic geographic distribution allows them to respond to and report disaster information in real-time. Amidst the vast pool of disaster-related information, the data from the JPGs can act as the benchmark for verifying authenticity on the Internet. Furthermore, the central objective of JPGs is to prevent and minimize the loss of lives during extreme events. Given that decision-makers, emergency responders, and stakeholders need real-time, reliable, secure, and comprehensive information for patient rescue and care, the information provided by the JPGs can serve as the standard for consolidating accurate data and filtering out any attempts at sabotage.

2. RETRIEVING DISASTER INFORMATION FROM SOCIAL MEDIA

Information is dominant in managing natural and manmade disasters (Kongthon et al., 2014). Faithful disaster information presents the true status of on-scene matters in a disaster area. Disaster information can be disseminated quickly on social media, including truth and fiction (Meserole, 2018; Pennycook et al., 2020). Social media, such as Twitter, Facebook, and Instagram, are indispensable sources for the public to obtain disaster information by mapping the episodes. The issues that readers are concerned about can be classified into at least four categories (Imran et al., 2013). First, the information of caution and advice to provide the pre- and real-time warning or pieces of advice regarding the disaster impact. Second, the condition of casualties and damage for being aware of the hazards of a disaster. Third, donations of goods, money, or services to understand the insufficiency of disaster response needs. Finally, in situations involving missing individuals, they rely on ongoing messages about missing or found persons resulting from the incident. However, emergency response teamers will not accept unproven disaster information on social media for action plans. Some previous studies can help extract information nuggets from disaster-related message pools and rapidly assess disaster damage by analyzing social media activity (Kryvasheyeu et al., 2016).

This research can only extend the application of disaster information on social media, yet the screening process is still an issue for retrieving valuable and precise data. For instance, at 09:02, on 29 May 2012, a calamitous earthquake struck the Emilia-Romagna and Lombardy regions of northern Italy. Seventeen people lost their lives, and the seismic event damaged 40 municipalities. A clear and informative picture of the earthquake was available within 50 minutes on the Internet (Alexander, 2014). Additionally, on 6 February 2016, southern Taiwan was jolted by a magnitude 6.4 earthquake (0206 Tainan earthquake) at 03:57, and 513 people were killed and injured in this disaster (Lin et al., 2016). Within 10 minutes, messages and images were posted on social media after the earthquake (Pan et al., 2018). Nevertheless, one year later, of the "0206 Tainan earthquake" in the same city, two people shared synthetic fake pictures on social media, causing panic among the inhabitants during a magnitude 6.0 earthquake at 01:12 on 11 February 2017. Based on a questionnaire analysis, 80% of the U.S. populace and 69% of online users agreed to help the national emergency response sector visit social networking sites regularly (Barr, 2011). Unfortunately, since some official agencies are afraid that the information from social media may be inaccurate and suspicious, they never monitor the social web information for reference (Goolsby, 2010). The utilization of information from social media is in a dilemma; therefore, mass information screening measures, such as the JPG method, shall be developed and innovated to expand the benefits and diminish the drawbacks of disaster information from social media.

3. DISASTER INFORMATION TRANSDUCTION PATHWAY

Disaster information can be collected from different sources, such as social media, witnesses, disaster inspectors, unmanned aerial vehicles, physical sensors, closed-circuit television, and satellites. Due to the popularity and circulation of information on social media, an enormous amount of information data will be obtained via the Internet in a disaster compared to only a tiny portion of precise information on social media that can be employed in an emergency. Although social media can create a massive disaster information supply in a catastrophic disaster, the quality of messages should be considered for further disaster response applications. Therefore, disaster information on social media without proof is scarcely utilized in official administrative sectors (Keller et al., 2014), which will cause problems for local and central governments. The local governments, especially their emergency response teams, cannot retrieve enough disaster information to plan an adequate implementation strategy. Besides, the collected information data cannot depict a real-time critical condition of a disaster for transferring upwards to the central government. On the contrary, information on disaster response policies and orders cannot be propagated nationwide without social media facilitation. The disaster information transduction pathway exists as a gap between the local and central governments. Hence, the data screening process is significant for retrieving pivotal disaster data from the social media information pool while the JPG is designed for this purpose. The disaster information will not only be collected but also screened by JPGs. The role of JPG is similar to a jigsaw puzzle; only the correct piece of the puzzle can be put in the fitting place to finalize the whole picture. That is to say, different fragments of disaster information can map the full spectrum of a disaster event, which can be favorable to the decision-makers and first-response sectors.

Since a JPG is designed as an information bridge between the local and central government, the disaster information will be transmitted upstream and downstream between both governmental ends. The JPG is critical to disaster information transduction, especially in an MCI, since the JPGs can help collect the local disaster information for the central government and transmit the integrated information and instructions of the central administrative sectors to the local governments. JPGs will also receive requests from the coordinator to conduct direct and intensive investigations to assemble the disaster information. A flowchart of disaster information delivery between local and central governments with JPGs is illustrated in Figure 1.

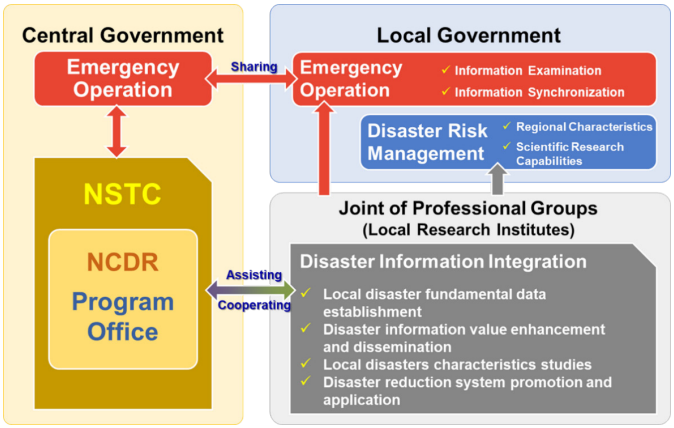

Fig. 1 The disaster information delivery between the central and local government with JPGs.(JPG, Joint Professional Group; NSTC, National Science and Technology; NCDR, National Science and Technology Council; NCDR, National Science and Technology Center for Disaster Reduction. Adapted from: NCDR publications.)

The COVID-19 information in Taiwan is regulated by the Central Epidemic Command Center (CECC). Members of the general public who are not authorized medical personnel cannot access information about infected patients. Consequently, if the JPG aims to provide information services during an epidemic, its focus should be on the supply and demand of personal protective equipment, the distribution status of local epidemic prevention materials, and the epidemic prevention requirements of residents. One of the vital functions of the JPG is information confirmation and error detection, which was highly effective during the COVID-19 pandemic. Moreover, if authorized, the JPG can serve as a crucial bridge between the central and local levels for epidemic information that does not involve the personal data of infected patients. Additionally, since JPG members are mainly university staff, they possess a deep understanding of the epidemic's impact on higher education and can provide relevant information to central education authorities.

4. EMERGENCY MEDICAL SERVICE IN TAIWAN

In an MCI, the emergency medical service (EMS) systems will be the initial response sector to manage casualties in a catastrophic event, and emergency medical technicians (EMTs) may be the first responders to provide first aid to patients. EMS systems are thoroughly distinct in different countries according to their constitution of the EMS teams, action plans, organizational strategies, and transportation models. Based on the EMS transportation patterns, there are two major categories, the Anglo-American model, which applies the "patient-to-doctor" policy, and the Franco-German model follows the "doctor-to-patient" plan (Dick, 2003; Dykstra, 1997; VanRooyen et al., 1999). In Taiwan, the Anglo-American model is employed in the EMS system, and the patients will be transported to hospitals commonly by two EMTs. Moreover, the EMTs can report real-time casualty conditions and disaster information to the stakeholders and commanders. Although the quality of information from EMTs is pretty high, the quantity is relatively low compared to social media information.

Previous studies have reviewed some weaknesses of Taiwan's EMS system during the emergency response (Huang et al., 2022; Chiang et al., 2009). Two factors, inadequate communication, and misinformation in disaster response, were emphasized and analyzed. In order to respond effectively, real-time information should be collected and analyzed for estimating needs and available assets that can be modified abruptly. Accurate information such as the condition of the disaster area, casualties, medical requirements, and severe, moderate, and mild populations will affect the usage and preparedness of supporting resources, including available ambulances, emergency department beds, hospital wards, and intensive care units. Communication can boost disaster information exchange among cross-jurisdictional agencies. The impact of communication and information exchange was evidenced by the World Trade Center attacks on 11 September 2001. The previous analysis suggested that "lack of communication probably resulted in more problems than all other factors combined." (Simon and Teperman, 2001) The same weaknesses were also highlighted in Taiwan's EMS system. Correspondingly, poor communication between the Ministry of Health and Welfare (in charge of hospital medical care affairs) and the National Fire Agency (in charge of pre-hospital emergency care affairs). In addition, disaster information collection still left space for improvement.

The emergence of JPGs has the potential to compensate for the lack of information available to EMTs. The JPGs can proactively collect information through various means such as CCTV, UAVs, social media, volunteers, or team members to provide a scenario of the situation on the site. This information is extremely valuable, especially for EMTs, as it helps them to understand the full spectrum of disaster development and damage. The EMTs and JPGs have established LINE groups and participated in joint drills to strengthen the connection between them in the event of a disaster. These initiatives allow them to work more closely with each other and exchange accurate information during practical actions.

5. JPG IMPLEMENTATION PROJECT

The "The Integration and Management of Disaster Information between Central and Local Government" project has been executed and administered by the National Science and Technology Center for Disaster Reduction (NCDR) since 2018 in Taiwan. It is an extended serial project from preliminary plans initiated in 2015. An ongoing and expanded project titled"Township Resilience and Disaster Risk Reduction Adaptation of Extreme Weather Disasters- the Central Plan" has been executed in 2022. The principal purposes of this project are to collect and screen the local disaster information by the project research teams involved and facilitate the flow of information between the central and local governments. Nonetheless, the demonstrated disaster information will cater to the needs of all the information requesters, especially disaster responders. Twenty-two research teams for each administrative district with more than 200 experts from 18 universities were invited to collaborate on the project. The teams have a broad spectrum covering all administrative districts in Taiwan, including 3 provincial cities, 11 counties, and 6 municipalities (Figure 2). However, the JPG members will need to be expanded and reorganized according to the characteristics of disasters, especially biological disasters. They have taken the responsibility to collect, screen, and integrate the local disaster information and act as an information bridge between the local and central government. The primary information exchange platform is the widely used instant communication (social media) app "LINE" in Taiwan (Wu et al.,2022; Lin et al., 2020). Over one hundred and fifty-six core experts cooperated with the LINE group which is administered and

coordinated by NCDR. The members from the academic sector in this project can feed precise data and expert commentaries back to the administrator and other information demanders.

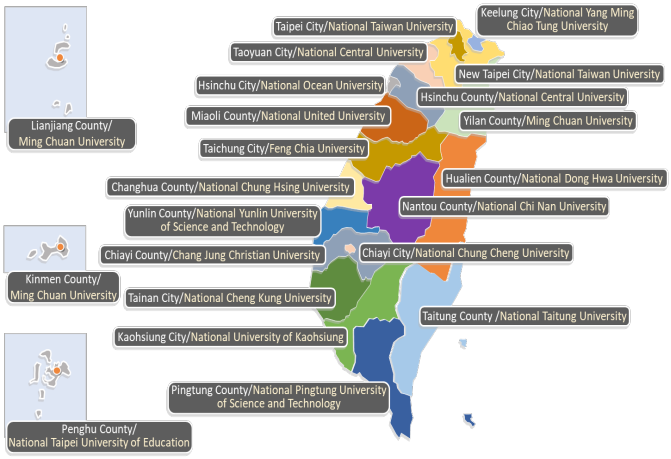

Fig. 2 Responsible area and geographical distribution of the JPG teams in Taiwan. (JPG: Joint Professional Group)

After undergoing annual review and improvement, the JPG project has successfully transitioned from theory to practice. The flow of disaster-related information has been streamlined between the central and local governments and vice versa. The local JPGs can harvest accurate disaster information from social media and their investigations, and the collected information is then reported upwards to the central government and disseminated downwards to the local governments as well as official end users. In addition, the linking function of JPGs serves to bridge the information gap between the administrative sectors, ensuring efficient coordination and communication.

6. ACTIONS AND ACHIEVEMENTS

The NCDR webmaster is liable for regularly posting the central government's policies and official activities in the designated LINE group. Besides, warning messages, announcements, and notices from various administrative units can also be observed in the Group. Academic participants also contribute by sharing information on weather conditions, minor local incidents, and disaster-related affairs of local governments. The LINE group can be defined as a task-oriented group that strictly focuses on its objectives, without engaging in small talk, gossip, or verbal dispute.

During the emergency response phase, the NCDR will release all the disaster-related information from various sources, including official agencies in the LINE group. Academic experts can also share the locally collected disaster information with the NCDR webmaster and other stakeholders. As a result, rigorous disaster information has a bottom-up flow, from local JPG to the central decision-makers, even to the President, and vice versa. The verified information can assist officers from the central government in perceiving the real-time status of the disaster development and taking necessary action. Moreover, it can also help local governments initiate adequate, effective, and efficient emergency responses.

The function of the LINE group was initially recognized during a flood disaster caused by a hazardous tropical depression in Taiwan on 23 August 2018 (Wikipedia, 2018). This event resulted in extensive flooding in the west-southern part of Taiwan due to torrential rain. It caused approximately US$35.5 million in damages, and 8,492 people had to evacuate from disaster-stricken areas to shelters over the course of eight days (2018.08.23 – 2018.08.30). This event can be classified as a diffused disaster due to a larger disaster-impacted area. In such disasters, compiling trustworthy disaster information becomes more challenging due to the vast territories impacted, including at least thirteen administrative districts. However, a complete disaster information spectrum can be exhibited well due to the local JPG's effort. The JPG LINE group surged with remarkable messages from local experts' responses to deliver the approved disaster information during the flooding event (Figure 3). The Pearson Correlation method detected a high correlation between messages and precipitation with a coefficient of 7.79, which shows that the JPG was actively sharing and analyzing the collected data in the LINE group according to the catastrophic event development.

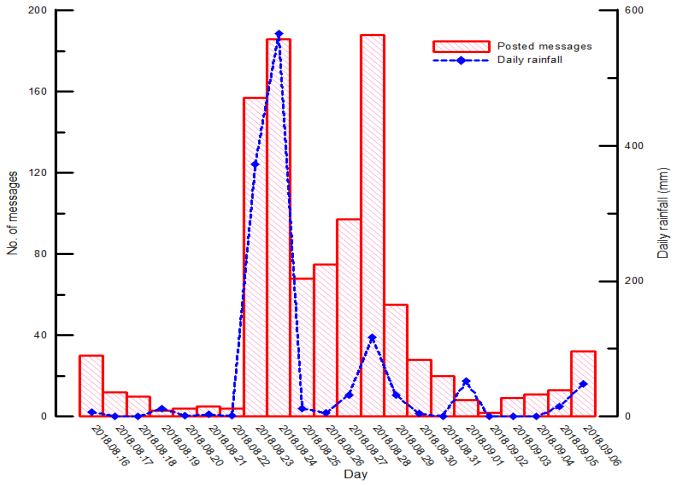

Fig. 3 The number of messages posted in the JPG LINE group during the tropical depression in Taiwan on 23 August 2018. The daily rainfall was recorded by Zeng Wen Xin Cun station based on the official datasheet of the Water Resources Agency, Ministry of Economic Affairs. (JPG, Joint Professional Group)

During the period of flooding, an overwhelming influx of disaster data surged in the response sectors, yet the quantity of information fell short of the requirements for comprehensive big data screening and mapping. The local JPGs emerged as key players, demonstrating their expertise in adding data, conducting meticulous proofreading, and exercising discernment. Their dedicated efforts enabled the creation of real-time, comprehensive depictions of the unfolding disaster within their respective areas of responsibility. Effective communication and data exchange was facilitated through the LINE group, while the NCDR webmaster played a pivotal role in data analysis, integration, and dissemination, catering to the needs of decision-makers and other interested parties.

This event helps as an invaluable lesson, underscoring the importance of JPGs in dealing with chaotic information during an MCI. Through their unwavering dedication, JPGs successfully screened, proofread, and mapped data, thereby providing an accurate and dynamic picture of the disaster's development in real-time. The locally sourced data collected by JPGs became a vital source of information for the central administrators. The latest real-time disaster information exchange data collected by the JPG during 2017-2019 is depicted in Figure 4. The information

includes early disaster warning, disaster preparation, information assessment, and local disaster situations to boost cooperation between the central and local governments in disaster response. The JPGs primarily utilize LINE groups, the LINE disaster reporting system, and e-mail as information exchange channels to share all aspects of disaster-related matters.

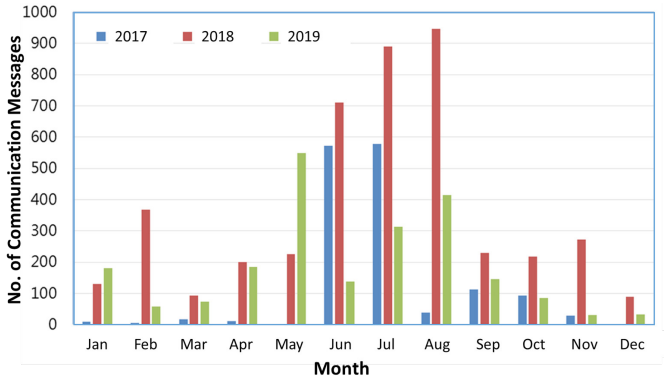

Fig. 4 Communication messages of disaster information collected by the JPGs during 2017-2019. (JPG, Joint Professional Group. Adapted from: NCDR publications.)

In addition to instant communication software (LINE) for hazard warning and information dissemination, the NCDR has developed and implemented other tools to facilitate information collection, delivery, exchange, and spreading for the central and local governments. The upgraded "County and City Disaster Information Network" can monitor various natural disasters, such as flooding, slope sliding, and drought, by estimating the impact area, calculating the affected population, and evaluating accessible resources for pre-warning and response. The information platform can provide decision-makers with an in-depth analysis of the updated condition of disaster development to modify response strategies. Furthermore, the JPGs collect disaster images from various sources, marking the spatial position in ArcGIS to build the Disaster Story Map. In this story map platform, each JPG created and edited the Dashboard for their responsible county, laying out the local vulnerability and risk potential. The disaster story map can provide the first responders and local governments with real-time disaster information during emergency response. However, for the fruitful results of the JPG plan to be included in the official disaster response policy, the government must provide official certification for the JPG collected information to be incorporated into the official emergency response plan and maintain the system and platform after comprehending the results of the JPG plan.

7. BENEFITS OF JPG

One of the vital roles of the JPG is to filter and authenticate the multitude of fragmented and disparate disaster data from various sources. A team of well-trained personnel is responsible for integrating and validating these fragments and episodes of disaster information to present a comprehensive view of the disaster to decision-makers and stakeholders. That is the fundamental purpose of the JPG concept.

In a catastrophic disaster, especially a large MCI, the central and local governments must coordinate their efforts effectively to minimize loss of life and property. However, a significant challenge arises due to the information and communication gap between these two entities for implementing a cohesive response plan because uncertain or fake information proliferates across the social media pool, and the official information exchange between the central and local governments is sluggish and limited in terms of reliable data. The local JPGs can act as an information bridge to collect, screen, and share information nuggets from social media to the local governments and the NCDR, which serves as the central government's information window.

The JPG project operates as an effective tool in combating the infodemic by enabling screening, customization, and verification of a substantial amount of disaster information. The JPGs play a crucial role in excluding unreliable, fake, and ambiguous disaster information from social media, thereby improving the circulation of precise information. This work holds immense importance as misinformation spreads more rapidly than the truth (Swire-Thompson and Lazer, 2020), causing panic and impeding decision-makers from making accurate judgments. For example, a fake story of a waterfall-like rainstorm emerged, portraying a waterfall-like rainstorm originating from a mountain area, misleadingly suggesting torrential rain in specific regions during a hazardous tropical depression in Taiwan. The manipulated video quickly spread across social media, leading to anxiety among local inhabitants. However, the JPGs promptly detected the misinformation, and the NCDR webmaster requested the responsible local JPG to clarify the suspicious video. The JPG LINE group shared rainfall records, real-scene photos, and the source of the fake video to expose the false narrative. This information was also disseminated on public social media platforms to alleviate the residents' stress.

During a disaster, a significant portion of the population present at the scene consists of non-injured and minor-injured individuals, and they tend to share messages and updates on the Internet. When JPGs are involved, the information they provide will serve as a point of reference for data integration. Alternatively, in cases where no JPGs present at the disaster sites, the nearby JPGs can follow the orders of coordinators or commanders to detect and collect the information by different means. Furthermore, as all the members of the JPGs have been trained and registered, the data they provide can be deemed reliable, and the information sources can be traceable.

8. CONCLUSIONS

The management and verification of disaster information require the use of various strategies and devices. Although modern technologies have made the data collection possible, the role of human intervention in the data collection process remains essential. Human expertise is required to extract valuable and reliable information from a cluttered data pool, making it a potential arbiter of the collected data. Therefore, social media proofreading by JPGs will boost disaster information dissemination in a reliable, comprehensive, and real-time manner.

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