International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 11 Issue: 01 | Jan 2024 www.irjet.net p-ISSN: 2395-0072

Mass Fatality Incidence and Disaster Victim Identification- A Comprehensive Review

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Abstract

This comprehensive review delves into the intricacies of managing mass fatalities resulting from disasters, with a specific focus on the Disaster Victim Identification (DVI) process. Drawing insights from a wealth of data, the article navigates through the challenges and methodologies inherent in victim identification after mass disasters. Key aspects covered include the multidisciplinary nature of DVI, guided by international protocols such as those outlined by INTERPOL. Distinctions between open and closed disasters are explored, shedding light on their impact on DVI response strategies. Categorization into natural and human-made disasters illuminates the diverse dimensions of their effects. The review meticulously examines primary and secondary identification methods, encompassing friction ridge analysis, forensic odontology, DNA analysis, and anthropological considerations. It acknowledges the unique challenges presented by mass disasters, where traditional methods encounter limitations. Real-world applications are exemplified through case studies, including the 2004 Indian Ocean Tsunami, 2013 Uttarakhand Catastrophe, and 2010 Haiti Earthquake. These cases underscore the importance of strategic planning, international collaboration, and adherence to protocols in the DVI process. The article serves as a valuable resource for professionals in disaster management, forensic sciences, and humanitarian efforts, providing a holistic overview of mass fatality incidents and the evolving nature of DVI practices. Through this analysis, the review contributes to a deeper understanding of the complexities involved in victim identification, offering insights for improved preparedness and response strategies in the face of future disasters.

Keywords: Disaster Victim Identification (DVI), International protocols, Identification methods, Case studies, Preparedness and response strategies etc.

1. INTRODUCTION

India is widely recognized as one of the most disaster-prone nations globally, with approximately 80% of its geographical area deemed susceptible to various natural disasters. Between 2000 and 2009, an average of 65 million individuals in India experienced the impact of disasters annually, encompassing 3.25 million pregnant and lactating mothers. Furthermore, each year, around 8.45 million children under the age of 5 are affected by disasters, with 1.25 million of them experiencing malnutrition [1], [2]. A disaster denotes a profound disturbance in the operational fabric of a society, leading to substantial human, material, or environmental casualties that exceed the afflicted community's capability to effectively mobilize its own resources. Disasters, whether arising from natural forces or human activities, typically manifest as unanticipated occurrences characterized by unpredictable and considerable magnitudes of devastation. Responding to and managing disasters has consistently posed one of society's most formidable challenges. Disasters, especially those of human origin, cannot be accurately predicted but frequently lead to numerous injuries and fatalities [3]. The identification of victims assumes a pivotal role following any disaster (Nuzzolese E, 2007). Post-disaster victim identification encompasses all methods and procedures employed in mass victim identification, with ethical considerations playing a crucial role in DNA identification of human biological material from mass disasters [4]. In instances of mass fatalities, specialists from diverse disciplines are mobilized to swiftly locate and repatriate the deceased to their next of kin. Victim identification is not solely driven by religious and personal motives but also holds significant social-legal implications [5]. The disaster victim identification process can be broadly categorized into five stages: scene investigation, mortuary procedures, collection of deceased information, reconciliation, and data destruction [6]. Internationally recognized guidelines, such as those outlined in the INTERPOL (International Police) DVI manual, stress the application of standard quality and the dignified and respectful treatment of victims. Disaster Victim Identification (DVI) encompasses a five-stage procedure: scene investigation, mortuary processes, collection of ante-mortem data, matching, and cross-examination [7]. The Interpol DVI Standing Committee initially published disaster victim identification guidelines in 1984, advocating for a multidisciplinary approach and "best practice" utilization in DVI operations [8].

2. DISASTER CLASSIFICATION

It is imperative to delineate between open and closed forms of disasters, as the classification of such events exerts a profound impact on the strategic approach to Disaster Victim Identification (DVI). An open disaster signifies an extensive cataclysmic occurrence culminating in the demise of numerous unidentified individuals, for whom no pre-existing records or descriptive data are available. It proves arduous to ascertain the exact number of victims in the aftermath of such events, given the absence of a temporal reference point to initiate a missing persons list. In contrast, a closed disaster represents a major catastrophic event resulting in the demise of individuals affiliated with a predetermined, identifiable group (e.g., plane crashes with a passenger list). Ante-mortem comparative data can be promptly obtained in closed disasters owing to the presence of a reference point, such as a passenger manifest or an event participant log. Mass disasters fall into two primary categories: natural disasters and human-made disasters. Natural disasters arise from natural phenomena, including earthquakes, floods, hurricanes, tsunamis, volcanic eruptions, landslides, and wildfires. These disasters inflict extensive damage on infrastructure and property, often resulting in substantial loss of life. Human-made disasters, conversely, result from human activities, whether intentional or unintentional. Examples encompass terrorist attacks, industrial accidents, nuclear incidents, transportation mishaps (e.g., plane crashes, train derailments, and shipwrecks), and civil unrest (e.g., riots, protests, and civil wars)[9], [10]. Beyond these fundamental categories, mass disasters can be further classified based on their scale, encompassing local, regional, national, or international events. Additionally, they can be categorized according to the type of impact they exert, such as physical, psychological, or social ramifications[11], [12], [13], [14], [15], [16].

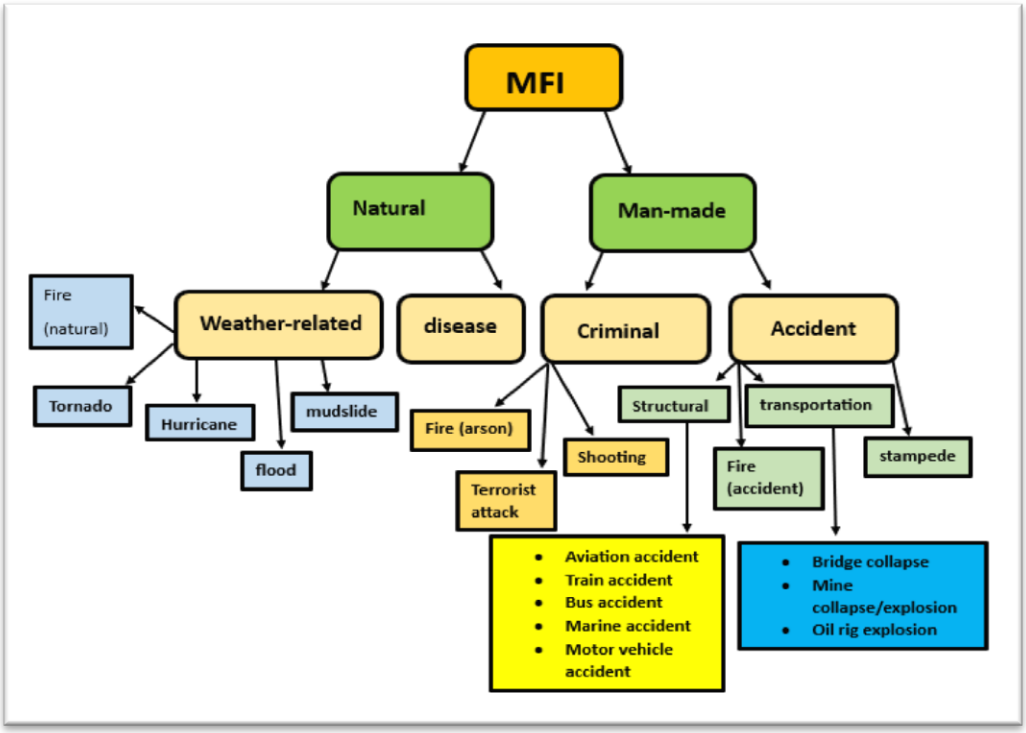

Figure 1: Types of Mass Fatality Incident (MFI)

3. EXPERTISE AND CONSIDERATIONS IN VICTIM IDENTIFICATION

Table-1: DVI Process Overview

Aspect	Details	References
Disaster Victim Identification (DVI)	A comprehensive interdisciplinary procedure designed for the expeditious and precise identification of deceased individuals following mass fatality incidents. This process involves the collaborative engagement of experts spanning diverse fields, aimed at facilitating the repatriation of the deceased, with particular emphasis on addressing religious, personal, and socio-legal considerations.	[5]
DVI Process Stages	- Scene - Mortuary - Collection of Deceased Information - Reconciliation - Destruction of Data. Spans from the occurrence of the disaster to victim identification (Rajshekar, 2014). Adherence to INTERPOL DVI guidelines is crucial, emphasizing standard quality and dignified treatment.	[6], [17]
DVI Phases	**a. Phase 1: Scene** - Ensures respect and consideration during the registration of each deceased individual. - Requires careful evaluation of security risks in chaotic and dangerous scenes before DVI personnel entry. **b. Phase 2: Post-mortem** - Conducts post-mortem examination after victim removal, employing scientific tests like dental examinations, fingerprinting, DNA profiling, and X-rays for accurate identification. **c. Phase 3: Ante-mortem** - Gathers crucial information from victim families through extensive interviews and completion of ante-mortem reports. Family-provided DNA samples aid in establishing relationships. **d. Phase 4: Reconciliation** - Expert teams reconcile post-mortem and ante-mortem data to identify the deceased. Identification Board, in consultation with the coroner, decides when the deceased can be released to their family.	[7], [18]
Cultural and Religious Considerations	Sensitivity to the cultural and religious aspects of mass death cases, striving to respect these practices during investigations (Blau S B. C., 2011).	[7]
Legal and Jurisdictional Requirements	DVI operations must adhere to the legal frameworks of the country where the disaster occurred, ensuring the legitimacy of the lead authority.	[19]
Planning a DVI Response	Strategic planning and established protocols are vital for a focused and effective response during and after an incident.	[18]
Summarizing the Phases of Identifying the Disaster Victim	- Collecting bodies, entering them into a unique death diary, conducting examinations, and assembling records for comparison. - A structured approach ensures the efficient release of identified victims to their families (Chauhan I, 2020).	[20]

4. METHODS OF IDENTIFICATION:

Confirmation of the identity of human remains in the case of mass death is only Board of Identification or after appropriate and reliable assessment data is transferred. Photo-based identification may be unreliable to some extent and should be kept as a single entity means of recognition. Visual identification by witnesses can show identity, but it is not enough to positively identify victims of large-scale disasters, because victims can be changed. the result of visual comparison is not reliable. Psychological stress is often involved conflict with the deceased and relatives makes this type of personality reliable [19].

Victim identification is not a peripheral consideration; rather, it constitutes an integral and indispensable component of the holistic analysis of any disaster. Thus, it is imperative to make this a standard practice, not solely for the purpose of ascertaining the cause and manner of death, but also for conducting comprehensive autopsies that encompass all aspects of

the disaster victims. This approach is not only crucial for understanding the immediate circumstances but also assumes significance in proactively preventing or mitigating the impact of future analogous events. The onus of this responsibility squarely rests on medical professionals, as fulfilling legal obligations necessitates the completion of thorough autopsies. Additionally, the collection of specimens and samples may be imperative for subsequent in-depth analyses.

There are methods of identification:

4.1 Primary Methods Of Identification:

Internationally recognized, the foremost determinant of identity verification lies in the most dependable methodologies. Key identifiers include "Friction Ridge Analysis," "Forensic Odontology," and DNA analysis. Widely adopted symbols are employed to denote individual identification methods. Fundamentally, the primary identification process involves discerning the victim's identity through the collaboration of various disciplines. Typically, the discovery is rooted in the aftermath of a disaster, with evidence contingent on factors such as the time of occurrence, the extent or stage of damage, and alterations in the victim's body position due to the delay in investigative efforts. Notably, DNA fingerprints, analysis of dental records, and ridge analysis stand out as the most reliable alternatives for identification purposes. [7], [18].

4.1.1 Friction Ridge Analysis:

Friction ridges, unique to the palmar (hands and fingers) and plantar (soles and toes) surfaces of the human body, exhibit unparalleled distinctiveness. These ridges, not duplicated on any other individual's structures, bestow a level of specificity that allows for decisive individualization or exclusion of persons. The continuity of these friction ridges, present since birth, persists unless enduring permanent damage or succumbing to advanced decomposition. Papillary ridges, formed in utero, maintain their presence even after death. Following minor injuries, they regenerate in the same pattern, while more severe injuries can lead to lasting scarring. Despite such alterations, these changes can still contribute significantly to the process of identification or exclusion [21].

4.1.2 Forensic Odontology:

The utilization of dental evidence for the identification of individual victims stands as one of the most reliable methods in such cases. Dental evidence, being a crucial and highly effective identification tool, often provides a level of precision in positively confirming a person's identity. An in-depth examination of the teeth and jaws requires the expertise of a forensic odontologist, who conducts a comprehensive oral assessment as part of a general autopsy.

DVI odontologists, when comparing post-mortem and ante-mortem dental records, derive results that fall into distinct categories:

- Identification (absolute certainty that PM and AM records belong to the same person).
- Probability of identification (specific features match between PM and AM, but PM or AM data or both are minimal).
- Identification possible (no de-identifying, but PM or AM information or both minimal).
- De-identification (PM and AM notes from different people).
- Not enough evidence (neither PM nor AM are comparable) [22].

4.1.3 DNA Analysis:

DNA material serves as an incontrovertible means of identification, constituting a vital component of the genetic information housed within a cell. This genetic code is unique to each individual, differentiating one person from another, with the exception of identical twins. DNA testing is particularly valuable in cases involving partially or severely decomposed remains, making it the optimal method for identifying body parts. Furthermore, DNA from previously collected medical samples or personal belongings of the victim can be employed for direct matching to remains.

DNA profiling and matching stand out as primary methods for identifying individuals missing in disasters, as outlined in the Interpol Disaster Victim Identification Guide. The process of DNA victim identification encompasses meticulous ante-mortem (AM) sample collection, judicious post-mortem (PM) sample selection, DNA analysis, and the application of statistical weighting to genetic relationships or comparisons. Each disaster presents a unique scenario, and the identification method for the deceased is determined by the specifics of each scenario [23].

Identification of victims through DNA analysis is the exclusive method for discerning the remains of the deceased. Regarded as a primary means in mass disaster victim identification, DNA analysis played a pivotal role in the DVI response to the Southeast Asian tsunami. Profiling DNA can be executed on a variety of body fluids and tissues. The statistical discriminative power of identifying one individual in a quadrillion renders DNA-based identification highly robust. Notably, this method proves successful irrespective of the body's severe condition, partial burns, post-mortem interval, or environmental factors. DNA analysis encompasses a range of samples, including blood, blood smears, bones, and tissues. In instances where samples are insufficient or degraded, mitochondrial DNA analysis becomes invaluable for victim identification. A burned body, when subjected to DNA analysis, should be considered negative. Successful DNA identification involves the meticulous collection of appropriate antemortem and post-mortem samples, along with the application of statistical weighting to assess genetic compatibility. Proper labeling, comprehensive documentation, and meticulous chain sampling are imperative for the integrity of the collection process. [24]

4.1.4 Applications Of Different Polymorphic Enzymes And Proteins:

By the utilizing the applied field of forensic proteomics; different polymorphic enzymes and proteins can be used as biological marker for identification of victims in cases of disasters. [25]

4.2 Secondary Methods Of Identification

Secondary identity mainly involves the individual effects and objects, tattoo marks, imprints, descriptions victim's clothing and jewellery, medical records. That is all can confirm with the information collected from them. The victim is the primary identification, but he cannot be conclusive evidence to identify the victim. Even if the photographs work for the purpose, it is not conclusive as false information may be collected. A secondary identifier serves as a valuable source of information, particularly in situations where access to primary identifiers may be restricted or unavailable. In cases where the selection of key identifiers is constrained, a secondary identifier can often stand as the sole method through which the identity of the deceased can be ascertained.

4.2.1 Medical Information:

Collected medical data can be categorized in various dimensions, including external versus internal distinctions, original versus acquired information, and the recognition of normal variations versus congenital diseases. While primarily obtained by medical professionals, it is advisable to include forensic anthropologists as part of the medical ante-mortem (AM) collection team to enhance the comprehensiveness and accuracy of the gathered data. An odd number is found in pacemakers and other prosthetic devices is a reliable limiting characteristic. Tattoos, moles, and configurations can be indicator's identity.

4.2.2 Pathology:

Abnormalities identified using the program are those that deviate significantly from what is common in the population identified by AM providers, information, often close relatives. There are many of them, but the more common ones should be mentioned. The shape of the head and the features in the eyes can also be seen. [2]

Eye color is rarely used post-mortem, but it can be valuable, as well as the shape of the pupil and the size and shape of the nose. Abdominal abnormalities of the skeleton can be seen from the outside. There are general changes in the extremities, such as bowed knees, the absence of normal fingers and toes, or the most common flexions between the fingers and especially the toes. [26]

The constitution and organization of Disaster Victim Identification (DVI) groups vary globally, and fortunately, DVI operations are typically not full-time endeavors. While some countries maintain a permanent team, often a compact unit dedicated to

equipment maintenance and training coordination, the establishment of a comprehensive network of correspondents across diverse domains is essential. Professionals seeking inclusion in a DVI group must adhere to specific criteria outlined in a specialized status document. In the field of forensic pathology, a pivotal role has traditionally been played in routine practices, accident investigations, and the identification of mass casualties involving hundreds or thousands of victims. Recent advancements in forensic odontology, genetics, and anthropology have significantly enhanced the capabilities for victim identification. As per the Interpol DVI manual, fingerprints, dental examinations, and DNA analyses stand as the primary modalities for identification, underscoring the growing significance of forensic pathologists as leaders of multidisciplinary teams in disaster scenarios. The expertise gained from analogous work in the routine operations of professional and forensic institutions proves invaluable. Tattoos, prevalent across genders and societal classes, serve as a common form of individual expression. While distinctive designs can aid in establishing uniqueness, opting for widely popular art may diminish their distinctive value. The discernment of cosmetic surgery requires professional scrutiny, as it often leaves subtle scars that can be strategically concealed in natural open areas or skin folds. [27], [28]

4.2.3 Anthropology:

A forensic anthropologist integrated into the ante-mortem (AM) team is adept at addressing issues related to body variations, complementing the insights of medical data practitioners with their specialized knowledge. The application of forensic anthropology in Disaster Victim Identification (DVI) extends over a century, with recent decades witnessing an elevated role for forensic anthropologists due to various catastrophic events. The experience gained from recent DVI operations has yielded valuable lessons that have reshaped the perceived value and role of forensic anthropologists within the comprehensive DVI case management team. Despite playing a crucial role in multiple stages of DVI, forensic anthropologists operate in collaboration rather than isolation.[29]

4.2.4 Articles/ Evidence/ Clothing:

The precise role of the forensic anthropologist in each of the five stages of the Disaster Victim Identification (DVI) process hinges on the condition and preservation status of the deceased, as well as the specific context and magnitude of the disaster. Evidence, a critical aspect, can yield significant information regarding the identity of the victim. However, it is essential to acknowledge that certain evidence may not unequivocally pertain to a particular individual. For instance, identification documents could have been acquired by someone else, jewelry or clothing items might have been temporarily lent to another person, or items could have been inadvertently placed in the wrong body bag during the search. The determinative value of objects is heightened when they are deeply associated or embedded within the body of the victim. Recognizing these nuances is pivotal for a thorough and accurate DVI process. [30], [31].

4.2.5 Bayes's theorem:

It is a statistical method used in forensic anthropology to estimate the probability that a set of skeletal remains belongs to a particular individual. It was first proposed by forensic anthropologist Walter G. Bayer in 1955.

The theorem is based on the concept of "multivariate probability" - that is, the probability of multiple variables occurring together. In the case of forensic anthropology, the variables in question are various skeletal measurements and characteristics, such as the length of bones, the angle of joint articulation, and the presence or absence of certain features like bony growths or dental abnormalities. [32]

Use Of Bayes' Theorem In Data Analysis And Interpretation

To apply Bayes's theorem, the forensic anthropologist first collects data on the relevant skeletal measurements and characteristics from the unidentified remains. They then compare these measurements to data on a reference population - that is, a group of individuals who are potentially related to the remains, such as family members or individuals who were known to be in the same area at the same time as the deceased.

Using multivariate statistics, the forensic anthropologist calculates the probability that the skeletal measurements and characteristics of the unidentified remains match those of the reference population. This probability is expressed as a

likelihood ratio, which represents the ratio of the probability that the remains belong to the individual in question (the "prosecution hypothesis") to the probability that they belong to someone else (the "null hypothesis").

The likelihood ratio is then used as evidence in court to support or refute the prosecution's case. A high likelihood ratio indicates that the skeletal measurements and characteristics of the unidentified remains are very likely to match those of the individual in question, while a low likelihood ratio indicates that they are more likely to belong to someone else. [32]

5. CYCLE OF THE DISASTER MANAGEMENT

The trajectory of the Haiti earthquake unfolds through distinct phases, encompassing the pre-disaster phase, impact phase, emergency phase, recovery phase, and reconstruction phase.

5.1 Pre-Disaster Phase:

The pre-disaster phase refers to the period of time leading up to the earthquake. During this phase, there were no warning signs of the impending disaster, and no emergency measures were put in place to prepare for such an event. As a result, the affected areas were not adequately prepared to respond to the disaster when it struck.

5.2 Impact Phase:

The impact phase denotes the immediate aftermath of the earthquake. Striking at 4:53 pm local time, the earthquake's epicenter was situated about 25 kilometers (16 mi) west of the capital, Port-au-Prince. This phase precipitated extensive devastation and loss of life, as numerous buildings and infrastructure succumbed to damage or destruction. [33]

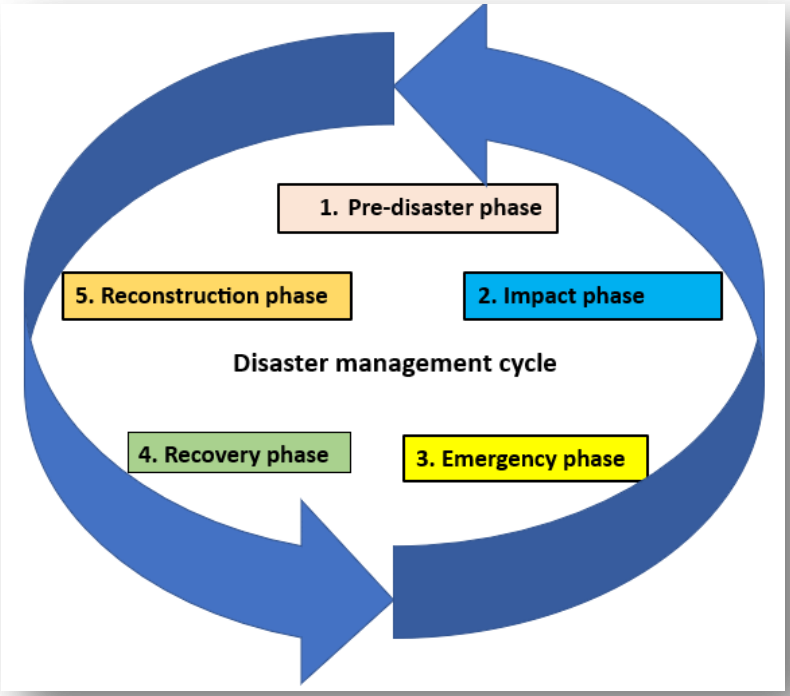

Figure 2: Catastrophe management cycle

5.3 Emergency Phase:

The emergency phase refers to the period of time immediately following the disaster. During this phase, emergency responders and aid organizations began to mobilize to provide assistance to the affected communities. In the case of the Haiti earthquake, the emergency phase was complicated by the fact that the affected areas were densely populated and lacked the necessary infrastructure to support relief efforts. [33]

5.4 Recovery Phase:

The recovery phase refers to the period of time following the emergency phase, during which efforts are made to recover and identify the victims of the disaster. In the case of the Haiti earthquake, recovery efforts were complicated by the fact that many of the affected areas were inaccessible due to damage to roads and infrastructure. Forensic anthropologists were called upon to assist in the identification of the victims. [33]

5.5 Reconstruction Phase:

The reconstruction phase refers to the period of time following the recovery phase, during which efforts are made to rebuild the affected communities and infrastructure. In the case of the Haiti earthquake, the reconstruction phase was a massive undertaking, as entire communities had been destroyed and needed to be rebuilt from scratch. [33]

6. CASE STUDIES

Table-2: Depicts different incidents related to mass disasters.

Instance Study	Details	References
1. 2004 Indian Ocean Tsunami	- Incident Date: December 26, 2004 - Time: 07:58:53 am local time (00:58:53 GMT) - Projected Fatalities: 227,898 - Epicenter: Off the western coast of Sumatra, Indonesia - Magnitude: 9.1-9.3 - Affected Regions: Indian Ocean countries, with Aceh, Indonesia, bearing the brunt of devastation - Identification Techniques: Predominantly relying on dental records, visual recognition, photographic evidence, DNA analysis, and fingerprint examination.	[20]
2. 2013 Uttarakhand Catastrophe	- Period: June 17–26, 2013 - Estimated Death Toll: 5748 - Missing: 4120 - Location: Uttarakhand, India - Causes: Cloudburst and Besoka Lake outburst - Rescue Operation: Operation Rahat & Surya - Identification: DNA samples, army, navy, and ITBP assistance, UID numbers for bodies, cremation facility utilization.	[34]
3. 2010 Haiti Earthquake	- Incident Date: January 12, 2010 - Time: 02:33 AM - Projected Casualties: 220,000 - Epicenter: 16 miles west of Port-au-Prince - Magnitude: 7 - Identification Techniques: Dental information, DNA results, fingerprint data, personal items collection - Guidelines: Interpol's disaster victim identification guidelines followed.	[20], [35]

7. THE EVOLUTION OF DISASTER VICTIM IDENTIFICATION OPERATING MODEL

Forensic experts and the Disaster Victim Identification (DVI) team necessitate a diverse array of tools to effectively execute their responsibilities. These tools encompass the establishment of temporary mortuaries, the implementation of suitable methods for packaging and preserving body remains at the scene, and the allocation of ample resources, all while considering cultural sensitivities and the nuanced associations and politics of the country where the DVI team is operating. Moreover, in dealing with mass disasters, it is commonplace to encounter victims of various nationalities, necessitating a thorough search for both direct and indirect sources for identifying bodies, particularly for non-European Union victims. Given the unique, stressful, and intricate nature of each disaster, a comprehensive multi-disciplinary approach becomes imperative to facilitate forensic identification of every victim in mass disaster events. Such an approach not only aids in the identification process but also plays a crucial role in addressing the unprecedented challenges that may emerge during such events. [36]

8. CONCLUSION

This review article intricately examines the challenges, processes, and methodologies inherent in managing mass fatalities resultant from disasters. A meticulous analysis of the data reveals key insights. It The article delineates the nuanced stages of the DVI process, emphasizing its multidisciplinary nature, involving experts across fields for precise and swift identification, guided by INTERPOL's international protocols. Further distinctions between open and closed disasters are made, recognizing their complexities and influence on DVI response strategies. Categorization into natural and human-made disasters elucidates their diverse impacts on physical, psychological, and social dimensions. Exploration of primary and secondary identification methods, such as friction ridge analysis, forensic odontology, DNA analysis, and anthropological considerations, enhances understanding. The article acknowledges unique challenges posed by mass disasters where traditional methods encounter limitations. Case studies, including the 2004 Indian Ocean Tsunami, 2013 Uttarakhand Catastrophe, and 2010 Haiti Earthquake, exemplify real-world DVI applications, emphasizing strategic planning, international collaboration, and adherence to protocols. the review provides a holistic overview of mass fatality incidents and disaster victim identification, addressing challenges, methodologies, and the evolving nature of DVI practices. A valuable resource for professionals in disaster management, forensic sciences, and humanitarian efforts.

REFERENCES:

[1] "UNICEF," https://www.un.org/en/ccoi/unicef-united-nations-childrens-fund#:~:text=The%20United%20Nations%20Children's%20Fund,devastated%20by%20World%20War%20II.

[2] R. Lessig and M. Rothschild, "International standards in cases of mass disaster victim identification (DVI)," *Forensic Sci Med Pathol*, vol. 8, pp. 197–199, 2012.

[3] P. Patil, "Disaster management in India," *Indian Res J*, vol. 2, no. 1, pp. 1–6, 2012.

[4] L. Caenazzo, P. Tozzo, and D. Rodriguez, "Ethical issues in DNA identification of human biological material from mass disasters," *Prehosp Disaster Med*, vol. 28, no. 4, pp. 393–396, 2013.

[5] A. L. Brough, B. Morgan, and G. N. Rutty, "The basics of disaster victim identification," *Journal of Forensic Radiology and Imaging*, vol. 3, no. 1, pp. 29–37, 2015.

[6] M. Rajshekar and M. Tennant, "The role of the forensic odontologist in disaster victim identification: a brief review," *Malays J Forensic Sci*, vol. 5, no. 1, pp. 78–85, 2014.

[7] S. Blau and C. A. Briggs, "The role of forensic anthropology in Disaster Victim Identification (DVI)," *Forensic Sci Int*, vol. 205, no. 1–3, pp. 29–35, 2011.

[8] P. Pittayapat, R. Jacobs, E. De Valck, D. Vandermeulen, and G. Willems, "Forensic odontology in the disaster victim identification process," *J Forensic Odontostomatol*, vol. 30, no. 1, p. 1, 2012.

[9] G. Kaur and B. Moza, "EXPLORING RAILWAY FORENSICS: TOP APPROACHES AND FUTURE DIRECTIONS," *Technology (Singap World Sci)*, vol. 14, no. 06, pp. 12561–12567, 2023.

[10] G. Kaur, D. Mukherjee, and B. Moza, "A Comprehensive Review of Wound Ballistics: Mechanisms, Effects, and Advancements," *International Journal of Medical Toxicology & Legal Medicine*, vol. 26, no. 3and4, pp. 189–196, 2023.

[11] "https://www.ojp.gov/sites/g/files/xyckuh241/files/media/document/nij-209493.pdf."

[12] "https://www.afp.gov.au/what-we-do/operational-support/forensics/explaining-disaster-victim-identification-process".

[13] "https://edisciplinas.usp.br/pluginfile.php/2510951/mod_resource/content/1/DVI%20INTERPOL%20GUIDE%202014.pdf."

[14] "https://edisciplinas.usp.br/pluginfile.php/2510951/mod_resource/content/1/DVI%20INTERPOL%20GUIDE%202014.pdf".

[15] "https://pubmed.ncbi.nlm.nih.gov/22009165/."

[16] "http://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000016FS/P000701/M015727/ET/1464334182FSC_P14_M13_e-text.pdf."

[17] V. Soni, "Forensic Medicine: A source and pathway of recognition in disaster victim identification".

[18] S. Blau and A. Hill, "Disaster victim identification: A review," *Minerva*, vol. 129, 2009.

[19] H. H. de Boer, S. Blau, T. Delabarde, and L. Hackman, "The role of forensic anthropology in disaster victim identification (DVI): recent developments and future prospects," *Forensic Sci Res*, vol. 4, no. 4, pp. 303–315, 2019.

[20] Pooja Puri and S K Shukla Isha Chauhan, "Disaster Victim Identification: A Strand that Connects to Forensics," *Austin J.of Forensic Science and Criminology*, vol. 7, no. 1, pp. 1–7, 2020.

[21] C. Ginther, L. Issel-Tarver, and M.-C. King, "Identifying individuals by sequencing mitochondrial DNA from teeth," *Nat Genet*, vol. 2, no. 2, pp. 135–138, Oct. 1992, doi: 10.1038/ng1092-135.

[22] N. Jain, "Ante-mortem dental records and forensic significance," *Indian Journal of Forensic Medicine & Toxicology*, vol. 7, no. 1, p. 42, 2013.

[23] K. Montelius and B. Lindblom, "DNA analysis in disaster victim identification," *Forensic Sci Med Pathol*, vol. 8, no. 2, pp. 140–147, 2012.

[24] V. K. L S, V. R. Vaswani, and L. K. Pramod, "DNA analysis in identifying mass disaster victims," *IP International Journal of Forensic Medicine and Toxicological Sciences*, vol. 3, no. 3, pp. 33–40, Dec. 2020, doi: 10.18231/2456-9615.2018.0010.

[25] V. Priyanka, M. Bhavika, and M. Debhjit, "Polymorphic enzymes and proteins in forensic science," *IP International Journal of Forensic Medicine and Toxicological Sciences*, vol. 2023, p. 19354, 2023, doi: 2456-9615.

[26] A. W. Lake, H. James, and J. W. Berketa, "Disaster victim identification: quality management from an odontology perspective," *Forensic Sci Med Pathol*, vol. 8, pp. 157–163, 2012.

[27] Y. Schuliar and P. J. T. Knudsen, "Role of forensic pathologists in mass disasters," *Forensic Sci Med Pathol*, vol. 8, pp. 164–173, 2012.

[28] O. U. Akpan and T. A. Yakubu, "A review of earthquake occurrences and observations in Nigeria," *Earthquake Science*, vol. 23, no. 3, pp. 289–294, 2010.

[29] A. M. Christensen, N. V Passalacqua, and E. J. Bartelink, *Forensic anthropology: current methods and practice*. Academic Press, 2019.

[30] A. Z. Mundorff, S. M. Black, S. Blau, S. M. Drawdry, and R. C. K. Shore, "Disaster victim management: role of anthropologist," in *Encyclopedia of forensic and legal medicine*, Elsevier, 2016, pp. 281–287.

[31] D. Mukherjee, B. Moza, S. Pathak, A. Choudhury, A. Saha, and P. Dhondiyal, "Interdisciplinary Collaborations and Advancements: Amplifying the Potential of Diatom Analysis," vol. 11, Jan. 2024.

[32] C. E. H. Berger, H. H. de Boer, and M. van Wijk, "Use of Bayes' Theorem in data analysis and interpretation," in *Statistics and probability in forensic anthropology*, Elsevier, 2020, pp. 125–135.

[33] "The Disaster Management Cycle: 5 Key Stages UCF Online," University of Central Florida https://www.ucf.edu .

[34] T. Ishwer, P. P. Malik, I. Mohammad, G. Maneel, and P. Chandra, "Uttrakhand disaster: Status of disaster victim identification in India," *Austin J Forensic Sci Criminol*, vol. 1, no. 1, p. 4, 2014.

[35] Handy Geography, "Earthquake Case Study (Haiti – Poor)," https://handygeography.wordpress.com/gcse/the-restless-earth-revision-materials/earthquake-case-study-haiti-poor/.

[36] News-Medical.net, "Forensic Identification in Mass Disasters," https://www.azolifesciences.com/article/Forensic-Identification-in-Mass-Disasters.aspx.