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Review article

Disaster Victim Identification in India: Forensic Challenges and the Need for a Comprehensive Legal–Policy Framework

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ABSTRACT

India is increasingly facing natural and human-made disasters, leading to large-scale fatalities. Accurate disaster victim identification (DVI) is essential for medico-legal, humanitarian, and psychosocial contexts. It upholds the dignity of the deceased by enabling the return of the remains to the family for final rites. However, India continues to face significant infrastructural, operational, and policy-related limitations in DVI. This study aimed to examine the role of forensic science in DVI, assess the operational and legal-policy shortcomings in India's DVI framework compared with international norms, investigate the psychological and humanitarian ramifications of delayed or incorrect identification, and propose a comprehensive legal-policy framework for DVI. This structured narrative review was conducted through a thorough literature search in PubMed, Scopus, and Google Scholar. The last date of search was 31.01.2026. The review was supplemented with existing legal-policy analysis and comparison of the Indian DVI scenario with international standards. Selected Indian disaster case studies between 1999 and 2025 were used to understand the major recurring challenges related to DVI in India. The data were synthesized using a thematic narrative approach. This study identified deficiencies in India's DVI preparedness and response- shortage of trained forensic experts, insufficient mortuary infrastructure, fragmented coordination between ante-mortem and post-mortem data, poor documentation practices, limited integration of DNA, biometric, and dental records, and a lack of standardized national protocols. A comparative analysis showed that India lags behind the UK, USA, and Australia in multidisciplinary coordination, technological integration, and family support mechanisms. Delayed or inaccurate identification contributes to prolonged grief, legal complications, and erosion of public trust. Hence, India requires a dedicated National DVI Act, specialized DVI institutions, integrated forensic databases, rapid-response,

multidisciplinary forensic teams, standardized INTERPOL-aligned protocols, ethical governance of genetic and biometric data, and strengthened psychosocial support systems for the families of the deceased.

KEYWORDS

forensic; disaster; disaster victim identification; psychosocial support; law; legal; policy; INTERPOL; India.

1. Introduction

India's diverse geo-climatic zones expose a large proportion of its landmass and its population to a range of hazards—from earthquakes, floods, cyclones, and landslides to industrial and chemical disasters, pandemics, and terror incidents (Ankalkoti & Yashodha, 2025). According to the Emergency Events Database (EM-DAT), India experienced 387 disasters between 1990 and 1999, of which 115 were natural. In comparison, between 2000 and 2025, the number rose to 837 disasters, including 424 natural disasters (Public EM-DAT Platform, 2026), indicating a steady increase in the frequency of natural disasters in the country. Each major disaster brings mass casualties, with more than 100,000 deaths in disasters in the 21st century to date (Public EM-DAT Platform, 2026). It poses significant challenges in the recovery, identification, and proper management of the deceased in mass disasters, especially if it is underwater victim identification due to poor visibility, location of bodies at considerable depth, and fragile cadavers (De Boer, Roberts, Delabarde, Mundorff, & Blau, 2020; Winskog, 2012). Comingled remains and fragmented body parts can make the identification of the deceased very difficult, especially in cases of burnt or charred bodies, or decomposed bodies (De Boer et al., 2020). The idea is to move away from depersonalized forensic terms such as “cadaver” or “dead bodies” and instead respect the dignity of the deceased by giving justice to them and the bereaved families (Vaswani, Caenazzo, & Congram, 2024). This highlights the importance of humanitarian forensic action, which is the application of forensic science to serve humanitarian endeavors that uphold human dignity and human rights (Cordner & Tidball-Binz, 2017). Humanitarian forensic actions are governed by International Humanitarian Law, and in disaster scenarios, they handle the identification of the deceased, management of the dead, investigation of abuse and torture, and psychosocial support for bereaved families (Cordner & Tidball-Binz, 2017). Hence, with societal, legal, and humanitarian implications, the management of the deceased is not only a health or logistical challenge but a critical test of India's rule of law, human dignity, and administrative systems (National Disaster Management Authority [NDMA], 2010).

This review addresses the following research questions:

- What are the major forensic and operational challenges in disaster victim identification (DVI) in India?
- How do existing Indian legal and disaster management frameworks address DVI?
- What psychosocial, humanitarian, and legal consequences arise from delayed or inaccurate victim identification?
- How does India's current DVI framework compare with international standards such as INTERPOL protocols?
- What legal-policy reforms are required to strengthen DVI preparedness in India?
- The aims and objectives of this review are:
 - To examine the role of forensic science in DVI;
 - To analyze current legal, infrastructural, and operational gaps in India's DVI framework;
 - To explore psychosocial, humanitarian, and legal implications associated with victim misidentification and delayed identification;
 - To compare Indian practices with international DVI standards;
 - To propose a comprehensive legal-policy framework for strengthening DVI systems in India.

2. Methods

This study employed a structured narrative review methodology supplemented by existing legal-policy analysis, comparative international framework analysis, and illustrative case-study examination.

A literature search was conducted using databases PubMed, Google Scholar, and Scopus. Search terms included combinations of: “disaster victim identification”, “mass fatality management”, “psychosocial impact”, “forensic science”, “forensic anthropology”, “forensic odontology”, “DNA identification”, “disaster law”, and “India”.

Relevant policy documents, national guidelines, legislative texts, and international protocols were also reviewed, including:

- INTERPOL Disaster Victim Identification Guide,
- Disaster Management Act 2005,
- National Disaster Management Guidelines,
- National Policy on Disaster Management 2009,
- DNA Technology (use and Application) Regulation Bill 2019,
- Bhartiya Nagarik Suraksha Sanhita 2023,
- International humanitarian forensic literature.

Articles published from database inception until 31st January 2026 were searched.

Additionally, selected Indian disaster case studies representing different types of mass fatality incidents between 1999 and 2025 were reviewed using reports from authentic national newspapers (“The Hindu”, “Times of India”, “The Indian Express” and “New Indian Express”) to illustrate recurring forensic and operational challenges in DVI. The case studies included the Odisha Super Cyclone (1999), Indian Ocean tsunami (2004), Uttarakhand flash floods (2013), Wayanad landslide (2024), Ahmedabad flight crash (2025), and railway accidents as an ongoing chronic mass fatality concern. These cases were analyzed to identify recurring systemic, medico-legal, and psychosocial gaps in DVI operations in India.

2.1. Inclusion Criteria

- English-language publications;
- Peer-reviewed articles, policy documents, legal texts, government guidelines, and reports from national and international agencies;
- Literature related to DVI, forensic science in disaster management, humanitarian forensics, forensic anthropology, forensic odontology, DNA-based identification, and medico-legal aspects of mass fatality management;
- Literature addressing psychosocial, ethical, cultural, legal, and humanitarian implications associated with DVI;
- National and international guidelines, frameworks, and standards relevant to DVI, including INTERPOL protocols and disaster management policies;
- Publications and reports relevant to the research questions and objectives of the review;
- Selected disaster case studies and documented incidents relevant to DVI practices and challenges in India.

2.2. Exclusion Criteria

- Articles unrelated to DVI or forensic disaster management;
- Studies focusing exclusively on non-disaster routine forensic identification;
- Duplicate publications;
- Non-English publications;
- Reports lacking sufficient methodological or contextual relevance to the objectives of the review.

2.3. Data Extraction and Analysis

Relevant literature, policy documents, Acts, and case studies were reviewed and synthesized using a thematic narrative approach. Information from the selected sources was categorized into major analytical domains, including:

- i) Role of forensic science in DVI,
- ii) Current landscape: Management of the deceased and forensic practices in India
- iii) Psychosocial and legal aspects of DVI after disaster,
- iv) Gaps and challenges in forensic DVI operations in India,
- v) INTERPOL DVI protocol implementation gaps,
- vi) Case studies: Failures and lessons

Comparative analysis was also undertaken between Indian practices and international DVI standards, particularly INTERPOL guidelines, to identify operational and policy gaps. Selected disaster case studies were used illustratively to contextualize recurring systemic challenges within the Indian setting.

Ethics approval was not required for this study as it is a narrative review.

3. Results

3.1. Role of Forensic Science in Disaster Victim Identification

Forensic medicine plays a vital role in situations where bodies are recovered beyond recognition. With the help of DNA analysis and matching, and using expertise from Forensic odontologists, anthropologists, and radiologists, forensic science supports DVI by ensuring identification of the deceased, toxicological investigation, and determination of cause and manner of death. For that to happen, collection and preservation of evidence via chain of custody, medico-legal documentation, and compliance with legal obligations are of utmost importance (Acharya, 2015; Sharma & Waghmode, 2021). According to INTERPOL's DVI guide, the role of forensic experts is important in all five phases- scene examination, post-mortem (PM) data collection, antemortem (AM) data collection, reconciliation, and debrief (INTERPOL, n.d.). According to the 'Management of Dead Bodies after Disaster' manual, each recovered human remains needs to be labeled with a unique code, which comprises the name of the place where it was found, the name of the team that located it, and a sequential number (Pan American Health Organization [PAHO], 2006). The code must also be written on the related photographs and on the dead body information form (PAHO, 2006). The labeled bag has to be refrigerated at 2-4°C, or else temporary burial (PAHO, 2006). For underwater DVI, the bagging of the deceased needs to be done the same way each time so that the pathologist can assess any injury; location and depth must be documented; the place has to be marked for revisit, and a search of the sand shall be conducted for belongings of the deceased (Winskog, 2012). The antemortem data for DNA matching can be collected by contacting family members. There are good sources of DNA (toothbrushes, electric razors, hair brushes, etc.), fair sources of DNA (lipstick,

deodorant sticks, pillowcases, cups, drinking glasses, used underwear, etc.), and poor sources of DNA (jewelry, watches, outer clothing, towels, shoes, hair bands, ear muffs, etc.) (Prinz et al., 2007). DNA can also be matched with nearest family members (parents, offspring, siblings) to identify the deceased with the help of blood samples (Prinz et al., 2007). Apart from DNA matching, dental structures can also be used for DVI as these are the most durable human tissues and can survive extreme heat, trauma, and decomposition (Acharya, 2015). Teeth were first used for identifying the dead in the 1897 explosion of a gas lamp of a cinematograph in Paris, which was called the Bazar de la Charité, where only 30 out of 126 deceased could be identified visually, and identification of the rest was done with the help of dental structures (Bruce-Chwatt, 2010). Forensic odontologists use differences in teeth morphology (crown dimensions, root lengths, mandibular and maxillary canine teeth dimorphism, mandibular canine index) for identification (Nagare, Chaudhari, Birangane, & Parkarwar, 2018). Forensic anthropologists use anthropometric dimensions of the hands and feet to help in victim identification, as lengths and breadths of hands and feet differ between males and females (Kanchan, Krishan, Sharma, & Menezes, 2010). However, the influence of genetics, ethnicity, and environment should be kept in mind, and population-specific standards are necessary for reliable clinical application (Sen, Kanchan, & Ghosh, 2011). Similarly, forensic experts do sex determination from the skull (craniofacial morphology, frontal sinus dimension), (Nagare et al., 2018) detection of Barr bodies and chromosomal analysis from pulp tissues or buccal smears using microscopic techniques, and advanced molecular techniques involve polymerase chain reaction (PCR) and amelogenin (AMEL) gene analysis, which provide highly accurate results even from degraded samples (Nagare et al., 2018). Additional approaches, with varying reliability, include rugoscopy (palatal rugae patterns) and cheiloscropy (lip prints) (Nagare et al., 2018).

3.2. Current Landscape: Management of the Deceased and Forensic Practices in India

The National Disaster Management Authority is in place in India, but current national policies emphasize medical rescue and relief more than forensics. The Disaster Management Act, 2005 assigns district authorities the responsibility of arranging disposal of unclaimed human remains but does not lay down detailed protocols for management of the same (The Disaster Management Act 2005, 2005). The National Policy on Disaster Management 2009 highlighted the need for adequate mortuary facilities and clear guidelines for the proper and speedy disposal of human and animal remains in disaster situations (National Policy on Disaster Management 2009, 2009). Following that, the National Disaster Management Guidelines for the Management of the Dead in the Aftermath of Disasters were published in India in August 2010. It emphasizes:

- Dignified and scientific identification and disposal of the deceased,
- Classification and roles for various responders (administrative, police, medical, forensic, community),
- Procedures for recovery, storage, preservation, identification, release, and disposal,
- Inclusion of primary (fingerprint, odontology, radiology, anthropology, DNA) and secondary (visual, personal effects, photography) identification methods,
- Procedures for data management, information dissemination, and support for bereaved families (NDMA, 2010).

While progressive in spirit, the guidelines have yet to be systematically translated into operational protocols under a legal framework, especially at state and district levels (Ankalkoti & Yashodha, 2025), as only the Odisha government's SOP became effective from 1st April, 2025 (Mehta, 2025). This approach creates inconsistent standards and procedural delays, with compromise in identification accuracy and compounded family trauma.

Additionally, the lack of a dedicated policy for the management of the deceased during epidemics or pandemics was brought to the forefront during the COVID-19 pandemic, owing to the associated risk of contagion.

3.3. Psychosocial and Legal Aspects of Disaster Victim Identification

The forensic challenges are further compounded by India's cultural diversity, where proper identification and respectful handling of the deceased are not merely procedural requirements but deeply embedded religious and cultural imperatives. Those can be -

(i) Families experience severe psychological distress due to misidentified bodies, especially when the wrong remains are given for funerals, or some remains are given after the funerals due to late identification (Times of India News Desk, 2025). Such incidents jeopardize human rights and dignity in a culturally diverse nation like India, where post-death rituals are extremely important (Nair, 2019). Mass or anonymous burial/cremation without identification affronts personal, community, and religious rights (Bureau, 2024).

(ii) Furthermore, in case of non-identification, families do not receive the body, which can lead to unacceptance of death (Isuru, Bandumithra, & Williams, 2021). If families remain unaware of the fate of their missing loved ones, they are at risk from the so-called "Zeigarnik effect", a failure for them to "find closure" and move on with their lives (MacLeod, 2020).

(iii) Even the long waiting time for identification of the body causes distress in close kin (Isuru, Hewage, Bandumithra, & Williams, 2019). These signify the importance of psychosocial support for the family members of the deceased.

(iv) Death certification is a prerequisite for inheritance, property transfer, insurance, remarriage, and, in some cases, employment benefits for families who lose the sole breadwinner. Inaccurate or missing identifications create lifelong limbo for families and survivors (Ishwer, Malik, Mohammad, Maneel, & Chandra, 2014; NDMA, 2010). Timely DVI prevents criminal misuse, fraudulent claims, and misappropriation of compensation funds (Mvunabandi, 2023).

(v) In situations of epidemics or pandemics with potential infection risks, families may not receive the bodies of their deceased relatives, resulting in considerable emotional and psychological stress (Mohammadi et al., 2021).

3.4. Gaps and Challenges in Forensic DVI Operations in India

Several recent disasters have exposed the gaps and challenges in forensic DVI operations in India. Those are described below-

3.4.1. Infrastructural and Human Resource Deficiencies

- Shortage of mortuaries, forensic labs (30 labs for a population of 1.4 billion, and the majority without advanced DNA analysis capabilities), and expert personnel (forensic pathologists, anthropologists, odontologists, and DNA analysts) renders timely and scientific identification challenging for large numbers of deceased (NDMA, 2010; 'What Really Is Holding Back Forensic Science in India?', 2023).
- Limited use of odontology and medical imaging for identification (Dutta, Singh, Passi, Varghese, & Sharma, 2016).

3.4.2. Procedural and Documentation Challenges

- Lack of standardized DVI procedures: Ad hoc, inconsistent approaches to tagging, cataloging, and preserving human remains and associated evidence (Ishwer et al., 2014).
- Improper chain of custody and missing data impede later identification and create legal problems for survivors seeking compensation (Kanishga & Bhargava, 2025).

- Absence of international collaboration due to non-existent cross-border protocols in India. A cross-border protocol exists for sharing AM/PM data in global disasters, managed by central nodes such as INTERPOL or the Red Cross. Services such as the EU-wide Schengen Information System enable cross-border matching (INTERPOL, n.d.; ‘FAST and Efficient International Disaster Victim Identification | FP7’, n.d.).

3.4.3. Legal and Policy Gaps

- The United Kingdom has developed a highly structured and humane approach to DVI. The system emphasizes dignity, accuracy, coordination, and family support throughout the identification process. Dedicated units such as the Casualty Bureau serve as central hubs for collecting and managing information related to victims, missing persons, and families during mass fatality incidents. Specially trained Family Liaison Officers act as the primary point of contact for bereaved families, helping them understand DVI procedures, collecting ante-mortem information, and facilitating access to support services. The UK model also highlights strong inter-agency coordination involving police, forensic experts, pathologists, local authorities, emergency services, and humanitarian agencies working together under clearly defined operational structures. Emphasis is placed not only on forensic accuracy and evidence preservation, but also on respectful handling of the deceased, transparent communication with families, and psychosocial support for survivors and the bereaved (‘DVI Roles and Responsibilities | College of Policing’, 2013).
- The United States has developed a highly organized and multidisciplinary DVI system centered around the Disaster Mortuary Operational Response Teams (DMORTs), which function under the U.S. Department of Health and Human Services. DMORT teams include forensic pathologists, anthropologists, odontologists, fingerprint specialists, mortuary personnel, and DNA experts who assist local authorities during mass fatality incidents such as natural disasters, terrorist attacks, aviation accidents, and pandemics. The U.S. model emphasizes scientific identification, standardized documentation, temporary morgue facilities, ante-mortem and post-mortem data reconciliation, and respectful return of remains to families. Family assistance is considered a central component of DVI operations, with the FBI (Federal Bureau of Investigation) supporting victim identification, communication, crisis response, and psychosocial services through Family Assistance Centers and Victim Services programs. The system also highlights inter-agency coordination, technological integration, and preparedness planning to ensure accurate and dignified management of the deceased during disasters (‘Disaster Mortuary Operational Response Teams’, n.d.).
- Australia has developed a multidisciplinary and highly coordinated approach to DVI, guided largely by INTERPOL protocols and supported by specialized forensic teams across disciplines such as DNA analysis, fingerprint examination, forensic odontology, pathology, and mortuary services. Australian DVI operations emphasize inter-agency collaboration, standardized documentation, scientific identification methods, and continuous professional learning from previous disasters. The system also recognizes the importance of cultural sensitivity, communication with families, teamwork across international settings, and psychosocial well-being of both affected families and forensic responders. Through participation in multiple national and international disasters, Australia has contributed significantly to the advancement of humanitarian forensic practices and operational preparedness in DVI (Adamovic, Howes, White, & Julian, 2023).
- In comparison to those countries, there is no clear legal mandate or protocol for coordinated DVI operations among agencies like police, forensics, health, and administration in India (Ishwer et al., 2014; Kanishga & Bhargava, 2025). Existing laws (Bharatiya Nagarik Suraksha Sanhita 2023, DM Act 2005) provide only general directions but lack specific mandates for forensic victim identification post-disaster (The Bharatiya Nagarik Suraksha Sanhita, 2023; The Disaster Management Act 2005, 2005). Besides the absence of a dedicated legal-policy framework for DVI, several other operational and systemic challenges exist, which are further

illustrated in Section 3.5 through a comparison of India's current framework with INTERPOL DVI standards.

3.4.4. Data Protection and Privacy

- DNA Technology (Use and Application) Regulation Bill, 2019 aimed to regulate DNA profiling for criminal investigation, missing persons, disaster victims, and civil disputes. (THE DNA TECHNOLOGY (USE AND APPLICATION) REGULATION BILL, 2019, 2019) It also proposed establishing a National DNA Data Bank and regional data banks like NDNAD (National DNA Database) in the United Kingdom (Wallace, 2006) and CODIS (Combined DNA Index System) in the United States. ('CODIS and NDIS Fact Sheet — FBI', n.d.) It had provisions on proper identification, preservation, and matching of DNA samples with safeguards for consent and privacy. However, the Bill has not yet been passed into law (as of September 2025). (THE DNA TECHNOLOGY (USE AND APPLICATION) REGULATION BILL, 2019, 2019)

3.4.5. Limited Use of Technology and Biometric Databases

- The International Commission on Missing Persons (ICMP), headquartered in The Hague, Netherlands, is an intergovernmental organization that works globally with governments, civil society organizations, judicial institutions, and international agencies to address the issue of persons missing due to armed conflicts, human rights violations, disasters, organized crime, irregular migration, and other humanitarian crises. ICMP supports the development of legal and institutional mechanisms for locating and identifying missing persons, strengthening forensic capacities, supporting affected families, and improving data management systems. Its work emphasizes a rights-based and humanitarian approach to the search and identification process, including the use of advanced forensic science and integrated data management systems. ICMP has been actively involved in multiple regions, including Europe, Central Asia, and Africa, and has contributed significantly to the development of international standards in missing persons investigations and DVI. ICMP uses iDMS (International Data Management System) ('About ICMP', n.d.).
- The Integrated Data Management System (iDMS) provides comprehensive informatics support for missing persons investigations—covering data collection from families, field recovery, postmortem examinations, and DNA analysis—by linking applications for Missing Persons, Field Operations, Examinations, AM-PM Comparison, and DNA Matching, and currently manages data on over 120,000 missing persons and 250,000 relatives across 150 countries (Rizvic et al., 2024).

India lacks integrated forensic information systems like iDMS. While Aadhaar provides biometric data for 1.38 billion Indians ('India Reports 1.38B Aadhaar Numbers Generated | Biometric Update', n.d.), its integration with forensic databases remains limited. There is a lack of centralized victim identification databases, and standardized data collection protocols impede inter-agency coordination and international co-operation (Ishwer et al., 2014; 'What Really Is Holding Back Forensic Science in India?', 2023).

3.4.6. Knowledge Gap in Dental Data Use

- In accordance with the Revised Dentists (Code of Ethics) Regulations of 2014 under the Dentist Act of 1948, all dental surgeons are required to keep outpatient and inpatient records, including radiological photographs, for a minimum of three years after treatment begins and to provide them within 72 hours of a legal authority's request (Indian Dental Association, 2014). The Indian Dental Association recommends retaining dental records for at least eight years ('Indian Dental Association', n.d.). It is very important for forensic odontology, which

applies dental principles to resolve legal issues (Ramakrishnan et al., 2015). Forensic odontologists play a significant role in identification. However, in a cross-sectional study, Kaul et al. found that nearly 80% of dentists were unaware of the ethical and medicolegal importance of maintaining dental records (Kaul, Gupta, Vaid, & Kaul, 2020).

3.5. INTERPOL DVI Protocol Implementation Gaps

The gap analysis compares international standards with current Indian practices across the principal phases of disaster victim identification, based on the INTERPOL DVI Guide (INTERPOL, 2023) (Table 1).

Table 1. Gap Analysis of Disaster Victim Identification Phases in India

DVI Phase	International Standards/Recommended Practice	Current Indian Reality	Key Gaps Identified
Scene Management	Systematic recovery of the deceased with evidence preservation, chain-of-custody protocols, and scene documentation	Retrieval processes are often ad hoc, with risks of contamination and inconsistent documentation.	Lack of standardized national protocols, limited training, weak scene management systems
Post-mortem Data Collection	Comprehensive examination of remains in dedicated mortuary facilities with quality control measures and multidisciplinary forensic input	Limited mortuary infrastructure, shortage of trained forensic personnel, variable quality standards	Capacity constraints, inadequate infrastructure, insufficient trained workforce
Ante-mortem Data Collection	Structured collection of missing persons' information from families, medical/dental records, and centralized databases	Poor availability of dental and medical records, fragmented record systems, limited database integration	Weak record-keeping systems, lack of integrated databases, infrastructure deficits
Reconciliation and Identification	Systematic comparison of ante-mortem and post-mortem data using forensic expertise, digital tools, and interoperable technology platforms	Predominantly manual processes with limited use of technology and shortage of specialized expertise mounting pressure on the forensic doctors for returning the body for last rites.	Technology deficits, limited interoperability, insufficient specialist capacity
Debrief and Family Communication	Structured review of response actions, transparent communication with families, psychosocial support, and preparedness planning	Delayed communication, inconsistent follow-up, and limited institutional review mechanisms. Lack of arrangements for the waiting family members and not having grief counselors for families.	Process failures, inadequate family support systems, absence of structured debrief mechanisms.

Note: AM = ante-mortem; DVI = disaster victim identification; PM = post-mortem. Source: INTERPOL (2023).

3.6. Case Studies: Failures and Lessons

3.6.1. Ahmedabad Flight Crash (2025): International Diplomatic Crisis

The crash of Air India flight AI-171 in June 2025 revealed significant shortcomings in forensic procedures. Multiple UK nationals' remains were wrongly identified and repatriated to Britain, causing "fresh pain to families." One family had to call off a funeral after discovering the coffin contained the wrong person. Another case involved commingled remains of multiple passengers placed in a single casket (C to I News Desk, 2025). Severe carbonization made dental identification impossible, especially for children whose molars were not fully developed (Raja, 2025). Given that more than 250 people were deceased, severe processing backlogs were found in DNA matching, causing families to wait for a prolonged time (Press Trust of India, 2025). The disaster exposed capacity gaps in India, requiring the deployment of UK forensic experts (Express News Service, 2025).

3.6.2. Wayanad Landslide (2024)

Many families requested to speed up the DNA testing to get some body parts of their loved ones for rituals, whereas some wanted DNA matching to get closure on the death of family members to move on (Bureau, 2024).

3.6.3. Uttarakhand Flash Floods (2013): Long-Term Identification Crisis

Of approximately 4,120 reported missing persons, only 20 deceased were positively identified from 550 DNA profiles processed by CDFD (Center for DNA Fingerprinting and Diagnostics), Hyderabad. After that, only 200 blood samples from families of missing persons were sent by the Uttarakhand Government to aid in victim identification, which is just a fraction compared to the number of missing individuals. Bodies continued to be discovered a year later, many reduced to skeletal remains. Even after a year, 471 death certificates remained unissued due to improper documentation, missing cell phone data, and lack of inter-state cooperation, pointing towards bureaucratic failure (Ishwer et al., 2014).

3.6.4. Indian Ocean Tsunami (2004)

Mass burial and rapid cremation, conducted under the belief that human remains posed an epidemic threat, resulted in numerous unidentifiable remains. International teams equipped with mobile labs performed far more efficient identifications, exposing the gap between Indian process and global best practice (Associated Press, 2024).

3.6.5. Odisha Super Cyclone (1999)

10,000 deaths- many were never found/ identified. Family members of only 4261 deceased received ex-gratia payment. Many wives denied the death of their husbands who went to sea for fishing due to no proof of death. They continued wearing vermilion, sankha, pola, which are traditional cultural symbols associated with married women in certain Indian communities, in the hope that their husbands would come back after 10 years ('Odisha: The Survivors of Odisha's 1999 Super Cyclone in an Everlasting Pain - ICSF', n.d.).

3.6.6. Railway Accidents: Chronic Identification Problems

Railway fatalities often involve extreme mutilation, making family recognition impossible, compounded by early decomposition changes and lack of efficient police procedures (Rao, 2022). 26%

of the deceased on railway tracks remain unidentified according to Karnataka railway police data (Kumaran, Mukesh, & Chavali, 2024). Moreover, distinguishing between accidental deaths, suicides, and homicides where bodies are disposed of on tracks to conceal evidence requires specialized forensic expertise often unavailable at district levels (Kumaran et al., 2024).

The selected major disaster events in India are summarized analytically in terms of DVI challenges, consequences, and key lessons learned (Table 2).

Table 2. Analytical Summary of Selected Major Disaster Events in India and Related Disaster Victim Identification (DVI) Challenges.

Disaster/Event	Type of Disaster	Major DVI and Forensic Challenges	Consequences	Key Lessons Learned
Odisha Super Cyclone (1999).	Natural disaster (Cyclone and flooding)	Large number of missing and unidentified victims; inadequate documentation systems; absence of structured DVI protocols; limited forensic infrastructure	Many families could not obtain proof of death or compensation; prolonged ambiguity regarding missing persons; psychosocial distress and unresolved grief among surviving family members.	Need for systematic victim documentation, centralized missing-person databases, timely death certification mechanisms, and psychosocial support services.
Indian Ocean Tsunami (2004).	Natural disaster (Tsunami)	Mass burials and rapid cremations without proper identification; limited forensic preparedness; poor awareness regarding preservation of remains	Numerous victims remained unidentified; loss of medico-legal evidence; distress among families due to inability to perform culturally appropriate rituals.	Importance of standardized DVI protocols, public awareness regarding handling of the deceased, and deployment of trained forensic response teams during mass fatality incidents
Uttarakhand Flash Floods (2013).	Natural disaster (Flash floods and landslides)	Severe decomposition and skeletal remains; inadequate collection of ante-mortem family samples; poor inter-state coordination; limited DNA matching capacity	Large number of missing persons remained unidentified; delays in issuance of death certificates; legal and administrative difficulties for families.	Need for integrated DNA databases, improved inter-state coordination, strengthened forensic laboratory capacity, and standardized data-sharing systems.
Wayanad Landslide (2024).	Natural disaster (Landslide)	Fragmented body parts and delayed identification; pressure for expedited DNA testing; limited capacity for rapid reconciliation of remains	Emotional distress among families awaiting identification; difficulties in conducting culturally significant last rites	Need for rapid DNA processing systems, efficient family communication mechanisms, and integration of psychosocial care into DVI operations.
Ahmedabad Flight Crash (2025).	Aviation disaster	Severe carbonization of bodies; commingled remains; processing delays in DNA identification; misidentification and repatriation errors	Diplomatic concerns; emotional trauma among families; delayed funerals; loss of public confidence in DVI systems	Importance of advanced forensic preparedness, quality-control mechanisms, international coordination, and standardized verification protocols before release of remains

Disaster/ Event	Type of Disaster	Major DVI and Forensic Challenges	Consequences	Key Lessons Learned
Railway Fatalities (Chronic Issue)	Transportation-related mass fatality incidents	Mutilated and decomposed remains; lack of standardized identification procedures; difficulty distinguishing accidental, suicidal, and homicidal deaths	High proportion of unidentified bodies; compromised medico-legal investigations; distress among families	Need for specialized railway forensic protocols, improved scene management, trained forensic personnel at district level, and enhanced medico-legal investigation systems.

Note: DVI = disaster victim identification. Source: Authors' synthesis based on the cited case-study sources.

3.7. Proposed Comprehensive Legal–Policy Framework

3.7.1. Legislative Reforms: Proposal for a National Disaster Victim Identification Act

This proposed law would serve as a comprehensive framework for handling disaster-related fatalities.

- It would make DVI procedures mandatory in all mass casualty events involving more than ten deaths.
- The National Forensic Coordination Authority would have powers for immediate deployment during emergencies.
- All forensic staff across the country would follow uniform certification and training standards, ensuring consistency and professionalism.
- It would also set up mechanisms for international cooperation, so that cross-border disasters can be managed jointly.
- Quality assurance standards would be enforced through regular audits to maintain accuracy and credibility.
- In cases of missing bodies, a defined time period should be established after which families may access bereavement-related support such as insurance claims, employment benefits, or job transfers, so as not to compound their emotional and financial distress. Clear guidelines must outline the order of eligibility for receiving such claims—spouse, children, parents, and siblings. In situations where the victim was cared for by individuals outside the immediate family, the claimant must provide appropriate proof to establish their eligibility for compensation.

3.7.2. Proposed Amendments to the Disaster Management Act 2005

To strengthen disaster response, the following updates are proposed:

- Forensic teams to be included in every disaster management plan.
- A percentage of the budget has to be reserved for disaster preparedness with respect to upcoming forensic challenges.
- Clear protocols for interagency coordination to be created, with well-defined command structures. Disaster training to be periodic and include the use of modern technology integrated into DVI practice.
- Psychosocial assistance to be made available for the immediate families of the deceased to help them cope with loss.

- There should be a well-defined policy outlining procedures for the safe handling of the deceased during epidemics or pandemics, balancing infection-control measures with respect for the dignity of the deceased. This should include provisions for conducting religious last rites and enabling families to observe them virtually through video conferencing. In situations requiring mass management of the deceased, protocols must ensure that various religious rituals—Hindu, Muslim, Christian, Sikh, and others—are performed sequentially, to respect the beliefs of all religions.

3.7.3. Development of Institutions

- National Disaster Victim Identification Center (NDVIC) can be developed as a specialized hub to ensure quick and coordinated responses during emergencies.
- A Central Command Structure needs to be functioning round the clock with 24/7 operational capability to oversee and guide all activities.
- Regional Response Teams can be strategically placed in disaster-prone areas so that help can reach affected regions without delay.
- Mobile Forensic Units need to be ready to move and can be deployed within just six hours of an incident.
- An International Liaison Office can be set up to strengthen cross-border coordination and support during large-scale disasters.

3.7.4. Specialized Team Structure

Dedicated expert teams will be created to ensure thorough and sensitive handling of victim identification.

- Forensic pathologists, anthropologists, and radiologists to study remains.
- DNA and dental specialists to confirm identities with precision.
- Digital forensics and data experts to manage records and information securely.
- Psychosocial support professionals to care for grieving families.
- Cultural liaison officers to ensure religious and cultural practices are respected during the process.

3.7.5. Technology Infrastructure Development

- An Integrated National Forensic Database can be designed to make the process of identifying people during disasters or investigations faster, safer, and more reliable.
- A national dental record repository will ensure that everyone's dental information is safely stored, since dental records are often one of the most reliable ways to confirm identity.
- With medical records connected from hospitals and clinics, vital health information can be accessed whenever it is needed most.
- And to keep everything running smoothly, real-time data sharing will be enabled through secure cloud platforms so that information can flow instantly to the right hands without delays.

3.7.6. Advanced Identification Technologies and Artificial Intelligence (AI)

These can be designed to bring cutting-edge science directly to the frontlines of disaster response and investigations like-

- Mobile DNA laboratories can be deployed right into the field, allowing experts to carry out genetic testing on-site instead of waiting for distant labs.
- With 3D facial reconstruction tools developed based on artificial intelligence (AI), even partial remains can be used to rebuild a face, giving families a greater chance of recognizing their loved ones.
- Automated biometric matching algorithms make the process of comparing fingerprints, iris scans, and other identifiers faster and more accurate than ever before.
- Use of AI to match the AM-PM data in an integrated data management system for identification of the deceased.
- To ensure no area is out of reach, satellite communication systems will keep teams connected and operational even in the most remote or disaster-struck locations.

3.7.7. Capacity Building and Training

A well-structured standardized protocol-based DVI system depends on well-prepared professionals and informed communities. India shall prioritize comprehensive professional development. Specialized DVI certification programs for forensic personnel and disaster forensics can be included in the MBBS course curriculum. International exchange opportunities with countries that have advanced DVI systems can expose Indian professionals to global best practices. Periodic training of forensic experts ensures that their knowledge and skills remain updated. Preparing the wider community is equally important. Community awareness campaigns can be taken up for systemic recovery of the bodies and body parts and handing over to forensic experts at the earliest without damaging them. Forensic experts can take up these activities during periods when no active disaster is there. A pool of first responders needs to be created by encouraging volunteers from the community. Sustainable funding from both government and non-governmental organizations along with international partnerships can ensure India's strengthened DVI capacity.

3.7.8. Performance Metrics and Accountability

- Progress should also be measurable and realistic, particularly for reforms to be meaningful when it comes to strengthening systems. Instead of needing immediate outcome targets in all aspects, phased policy targets may be considered to provide guidance and ensure implementation while monitoring progress over time. For example, in the next decade we might envision progressive enhancement of victim identification capacity (e.g., timely and with inter-agency coordination and accuracy as compared to current baseline levels used during major disasters). These indicators must always be considered aspirational and adapted to local capacities and resources available.
- Response preparedness and operational efficiency can be measured using simple benchmarks. These include sending trained teams on time, finishing initial assessments within set time limits, and regularly communicating with affected families. Over time, the goal is to complete more identifications faster while improving verification and reducing mistakes. Quality checks, accreditation, and clear communication with families can be planned gradually while improving the DVI systems in India.
- Accountability mechanisms can anchor this system. A National Forensic Audit Authority may conduct annual reviews, a Parliamentary Committee may track quarterly progress, and a judicial review mechanism may address grievances. International observers will add peer-reviewed credibility. Transparency can be strengthened through public dashboards displaying real-time metrics, annual reports, family feedback systems, and regular media briefings.

4. Discussion

4.1. Key Findings, Comparison with Existing Literature, and Potential Implications

This review highlights that DVI in India remains inadequately prepared despite the increasing frequency and scale of disasters in the country. Although forensic science offers multiple reliable methods for victim identification, including DNA profiling, forensic odontology, anthropology, radiology, and biometric analysis, their implementation in India remains fragmented and inconsistent. Existing national frameworks such as the Disaster Management Act 2005 and the National Disaster Management Guidelines (2010) recognize the importance of dignified management of the deceased. However, operationalization at state and district levels remains limited. The review demonstrates that deficiencies in mortuary infrastructure, shortage of trained forensic personnel, poor documentation practices, fragmented ante-mortem and post-mortem data systems, and limited use of integrated technologies continue to hinder timely and accurate identification. Comparative analysis with international DVI systems in countries such as the United Kingdom, the United States, and Australia further reveals that India lacks dedicated multidisciplinary DVI teams, standardized national protocols, integrated forensic databases, and robust inter-agency coordination mechanisms. A study of a series of disasters like Odisha Super Cyclone (1999), Indian Ocean tsunami (2004), Uttarakhand floods (2013), Wayanad landslide (2024), Ahmedabad flight crash (2025), and railway fatalities illustrates that DVI challenges in India are not isolated operational issues but persistent systemic deficiencies requiring structural reforms. Hence, while Barik et al. identified gaps between disaster awareness and practical preparedness, our review shows that similar preparedness deficits exist within India's forensic DVI systems, particularly regarding technological integration, standardized protocols, and AI-assisted identification capacities (Barik, Bhuyan, & Hodam, 2025).

The review also emphasizes that DVI extends beyond forensic identification and carries profound psychosocial, cultural, humanitarian, and legal implications. Delayed or inaccurate identification contributes to prolonged grief, emotional trauma, inability to perform culturally significant last rites, unresolved ambiguity regarding death, and legal complications related to inheritance, insurance, compensation, employment benefits, and remarriage. In a culturally diverse country like India, respectful handling and accurate identification of the deceased are closely linked with dignity, religious practices, and human rights. The findings therefore support the need for a comprehensive legal-policy framework incorporating standardized forensic protocols, dedicated disaster forensic institutions, integrated national databases, rapid-deployment forensic teams, psychosocial support systems, and specialized periodic training programs.

Here it is worth noting that the use of DNA and biometric databases in forensic identification has important implications for DVI, missing-person investigations, and criminal justice; however, it also raises substantial ethical, legal, and privacy concerns. Unlike conventional identifiers, DNA profiles and biometric markers such as fingerprints, iris scans, and facial recognition data are permanent, highly sensitive, and capable of revealing familial and personal information beyond simple identification. Existing literature cautions that integrating large-scale identity systems such as Aadhaar with forensic databases may be challenging (Wallace, Jackson, Gruber, & Thibedeau, 2014). Ethical concerns are particularly significant in humanitarian forensic contexts, where family members voluntarily provide DNA samples for the identification of deceased or missing relatives. The repurposing of such data for criminal investigations or long-term data banking without explicit informed consent may undermine public trust and discourage participation in future identification efforts. Therefore, it is emphasized that a clear distinction be maintained between humanitarian and criminal justice uses of biometric and genetic data to preserve the dignity, autonomy, and rights of affected individuals and families (Machado & Silva, 2015).

The literature further highlights the need for robust safeguards governing the collection, storage, sharing, and retention of forensic genetic and biometric information. Concerns regarding unauthorized access, data breaches, discriminatory profiling, and disproportionate surveillance of marginalized populations have been widely discussed in forensic ethics. Since genetic data are inherently familial and immutable, privacy violations may affect not only individuals but also their biologi-

cal relatives and communities (Wallace et al., 2014). Accordingly, stringent data protection measures must be followed, including purpose limitation, restricted access, encryption, transparent audit mechanisms, independent oversight bodies, and clearly defined retention and deletion policies (Machado & Silva, 2015). In the Indian context, these concerns assume greater relevance following the recognition of privacy as a fundamental right, underscoring the necessity for proportionality, accountability, and legal oversight in any future integration of biometric or genetic information into forensic identification systems.

Besides this, our recommendations regarding the integration of artificial intelligence (AI) into disaster victim identification (DVI) operations resonate with the broader concerns raised by Hanspal and Behera regarding the ethical and governance dimensions of AI-enabled disaster management in India (Hanspal & Behera, 2024, 2025). While previous literatures has primarily discussed AI in relation to disaster preparedness and response, the present review extends this discourse by emphasizing the potential role of AI in forensic reconciliation, biometric matching, AM–PM data integration, and rapid victim identification, while simultaneously underscoring the need for robust safeguards related to privacy, accountability, transparency, and humanitarian use of sensitive biometric and genetic data (Ocal & Torun, 2025).

Strengthening DVI preparedness in India requires not only technological advancement and legislative reform, but also sustained investment in humanitarian forensic practice, inter-agency coordination, ethical governance, and community-centered disaster response systems. Extending the broader disaster preparedness discourse highlighted by Cvetković and Planić, the present review emphasizes that disaster readiness must also include preparedness for post-disaster victim identification and humanitarian forensic response (Cvetković & Planić, 2022).

4.2. Limitations

The paper is based primarily on secondary sources like peer-reviewed articles, publicly available documents, legal texts, guidelines, and media reports. This opinion paper is drafted by individuals who have been working closely in the area of disaster with people affected by various disasters for more than 20 years in India, are regularly involved with the Indian ministry in formulating guidelines related to disasters in India, and are experts in forensic medicine and forensic psychiatry. However, the paper does not include any formal interviews with other forensic practitioners, disaster managers, policymakers, or affected families.

4.3. Directions for Future Research

Future studies could examine DVI capacities across Indian states, include interviews with forensic experts and disaster management officials, formally compare India with countries that have advanced DVI systems, and investigate the psychosocial consequences of delayed or incorrect identification of deceased families.

5. Conclusions

Having explored the evolving domains of forensic science applications in DVI and having analyzed the legal, infrastructural, and administrative gaps, we recommend the following:

- The process of DVI needs to be seriously considered and applied in disasters in order to prevent victim misidentification and nonidentification.
- The bereaved must get timely information and emotional support to tide them through the process of identification.
- Disaster management must also include timely management of human remains.

The implementation of a comprehensive legal and policy framework could, in this regard, represent a major milestone in strengthening India's disaster response system by safeguarding the rights and dignity of the deceased while upholding humanitarian principles.

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