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Article

Security and Surveillance at Large Religious Gatherings: Crowd Management Strategies for the 2025 Maha Kumbh Mela

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Abstract

The Maha Kumbh Mela 2025 was the most significant religious gathering of devotion and faith in the world. Over 660 million devotees bathed in sacred rivers in pursuit of spiritual liberation. Security measures and crowd management are major challenges for large-scale religious events. This paper contributes to existing literature on crowd management by examining crowd disasters, their major causes, security measures, crowd behavior, and traffic management. It assesses the coordination among various stakeholders, capacity planning, and overall organization. The paper provides a framework for risk assessment, preparedness, safety, and resource management. Its goal is to reduce the risk of incidents and ensure the safety and security of devotees during spiritual mass gatherings. Additionally, this study can aid in event management and policy development for future large-scale events, focusing on effective security strategies and strategic crowd management planning.

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1. INTRODUCTION

The World Health Organization (WHO) defines a mass gathering as a "gathering of more than a specified number of persons at a specific location for a particular purpose for a limited time." Mass religious gatherings or pilgrimages that attract large crowds are vulnerable to incidents like stampedes (Illiyas et al., 2013). Kumbh Mela is the largest mass gathering of people from anywhere in the world at a single location for a set period (Baranwal et al., 2015). During the Maha Kumbh Mela, there was a large movement of people traveling on foot in a crowd. According to traffic engineering principles, when a pedestrian crowd begins to behave unpredictably due to psychological and other influencing factors, making regulation difficult during mass gatherings, it is described as a pedestrian mob.

Safety and surveillance, along with pedestrian safety, have become significant and challenging (Gayathri et al., 2017). Bathing in rivers on specific days of the Hindu calendar during pilgrimage is believed to free one from sins and break the cycle of birth and death (Flood, 1996). Sacred immersion in major water bodies on auspicious days is regarded as serving various spiritual functions (Singh & Haigh, 2015). It attracts people from diverse demographic groups and all social strata (Barnett et al., 2016). Preachers, sages, priests, ascetics,

commoners, politicians, social workers, and elites all gather at the mela ground for different purposes (Encyclopaedia Britannica, 2020).

This is the largest gathering of humanity on earth (Vortmann et al., 2015). Kumbh Mela attracts millions of attendees from all over the world to participate in purification rituals at holy rivers. Given the enormous number of participants, there is a critical need for safety protocols and a comprehensive crowd management plan. Common crowd-related issues include crowd control, traffic diversion, crowd channelling, disaster management planning, scheduling and managing bathing times, and an emergency operations center for safety and security. There is also limited awareness of locations and event details. Poor crowd control, high crowd density, and restricted access points can lead to high-risk emergencies, including stampedes (Soomaroo & Murray, 2012).

According to the National Disaster Management Authority (NDMA), the main focus was on disaster prevention and preparedness. The framework must include capacity building, mitigation, preparedness, evacuation, response systems, relief, and rehabilitation. The shahi snan (royal bathing rituals) were supervised by thirteen akharas (monastic orders) on Makar Sankranti (first shahi snan), Mauni Amavasya (second shahi snan), and Basant Panchami (third shahi snan), as well as major bathing days like Paush Purnima and Maghi Purnima, including three shahi snan during the mela period. Due to the large number of people, risk assessment, security, preparedness, analysis, learning from past incidents, and innovative solutions are essential to ensure a safe and secure event.

The main goal of the research is to identify the factors that contribute to crowd management by studying crowd-related disasters and their primary causes. This study also aims to evaluate stakeholder coordination, assess capacity, and develop plans to ensure safety, preparedness, proper assessment, and efficient resource management at large religious gatherings.

In pursuit of this objective, the study addresses the following research questions:

1. What are the main causes of crowd disasters and the challenges of crowd management at large religious gatherings?
2. In managing the large influx of attendees, what role does stakeholder coordination play in the mass religious gathering?
3. How can a framework be developed for risk assessment, preparedness, safety, and efficient resource management?

This study adds to the scientific literature on crowd management by examining the main causes of crowd-related disasters and assessing the coordination among stakeholders, capacity evaluation, and planning. This information will help government agencies, event organizers, and managers develop their strategies and policies for managing crowds at large religious events.

2. ESSENCE OF MAHA KUMBH MELA 2025

The Maha Kumbh Mela is deeply rooted in Hindu mythology and the collective act of faith, exemplified by the world's largest public gathering. This assembly, offering wisdom, guidance, and opportunities for divine reflection, is attended by ascetics, sadhus, saints, sadhvis, kalpvasis, and pilgrims from all walks of life. Kumbh Mela is a major pilgrimage event in Hinduism. It takes place four times every 12 years at four revered locations in India. The locations rotate among Haridwar, Ujjain, Nashik, and Prayagraj, each situated on the banks of a sacred river, as shown in Table 1 (Memish et al., 2019; Raghav et al., 2020).

The celebration of each Kumbh Mela is based on the planetary positions of the sun, moon, and Jupiter. It is regarded as the holiest time in Hinduism, of spiritual significance, which attracts millions of pilgrims to bathe in the holy river to purify themselves from sins and attain spiritual liberation and self-enlightenment. The Kumbh Mela was declared an intangible cultural heritage by UNESCO in 2017. The Maha Kumbh Mela, a 45-day enriching journey celebrated from January 13 to February 26, 2025, was an expression of devotion, culture, traditions, and India's rich heritage. Its uniqueness lies in the occurrence of this mass religious gathering, which occurred after 144 years at Prayagraj (Prayagraj Mela Authority, n.d.). The magnificence of the event is reflected in the shahi snans, religious sermons, and cultural activities that draw millions of devotees to attend

the Kumbh Mela.

3. MATERIALS AND METHODS

Data was collected in several stages. First, the keywords 'Kumbh Mela,' 'Crowd management,' 'Mass religious gathering,' 'Security,' 'Crowd behavior,' and 'Capacity planning' were used to search for documents related to the research aims. The second step involved identifying the most useful databases, including Google Scholar, ResearchGate, PubMed, and ScienceDirect. Keywords from the first phase were used to search for potential document titles in these databases. Additionally, during the search, more studies were collected that did not contain the keywords but were closely related to the research topic and essential for explaining the concepts. Third, after selecting the academic documents, a database was created using only peer-reviewed articles, books, and book chapters in English. Various news sources, online websites, and government web portals were also browsed to gather relevant information related to Kumbh Mela, mass gatherings, and Magh Mela. The search was last conducted in June 2025. If certain studies directly or indirectly related to the current research objectives were overlooked, it was not intentional.

4. RESULTS AND DISCUSSION

4.1 Causes of triggers and crowd disasters

In mass gathering events, crowd management is a top priority in planning because it has significant potential to cause disruptions. Event preparation emphasizes planning, which is a major part of crowd management efforts. Systematic planning offers guidance, ensuring the safety and orderly development of events where large crowds gather (Martella et al., 2013). Effective crowd management involves proactively analyzing possible crowd-related issues and preparing to address them. This preparation includes anticipating potential problems and creating emergency plans (Health and Safety Executive, 2000). Managing large crowds requires consideration of architectural and infrastructural design elements, along with mechanisms for crowd monitoring and control to prevent potential disasters (Sharma et al., 2016).

Crowd management, especially during the snan days, has been a major challenge due to the high influx of pilgrims constantly arriving. An essential aspect of crowd management involves strategic planning to reduce crowd-related risks and prevent stampedes. The main issue during large gatherings is uncontrolled crowd movement, which the National Disaster Management Authority describes as "an act of mass impulse among a crowd of people in which the crowd collectively begins running with no clear direction or purpose." Stampedes mainly happen during religious events, sports games, and social gatherings that attract large numbers of people in crowded settings. Crowd disasters are categorized into six types: Structural, Fire/Electricity, Crowd Control, Crowd Behavior, Security, and Lack of coordination among stakeholders (NDMA, 2014).

Structure collapse occurs due to the failure of bridge railings, barricades, temporary structures, and makeshift bridges, often triggered by panic from rumors. The placement of structural barriers along pathways, along with poorly maintained guard rails and unlit stairwells, increases the risk of accidents. Many sacred places of worship are situated on challenging terrains, such as hilltops, which are inherently difficult to access and evacuate. The risk of danger rises in narrow staircases with windowless structures, limited and confined entry or exit points, and no clearly marked emergency exits. Fires often result from unauthorized structures that lack proper fire safety measures. The absence of fire extinguishers, illegal electrical connections, power failures, unsafe electrical fittings, and short circuits further heighten the danger. Insufficient control measures, limited capacity before entrances, closed exits, sudden access points, reliance on a single main exit, unmanaged parking, uncontrolled vehicle movement, and neglect of traffic regulations all compound the risk of accidents and chaos.

Crowd behavior can be dangerous, especially in large gatherings. The situation often becomes unstable during moments when pedestrian inflow and outflow meet, such as during a sudden crowd surge at the distribution of prasad, blankets, cash, or food. Negligent crowd actions, aggressive behavior caused by delays in trains or at the start of events, last-minute changes in train schedules, and unexpected pedestrian movements in the opposite direction disrupt crowd dynamics and increase safety risks. Challenges in coordinating among stakeholders like the district magistrate, fire services, shrine management, and the commissioner—along with a lack of awareness about each group's responsibilities—lead to confusion and administrative failures (Ramesh et al., 2021). Communication delays and poorly planned staffing during critical times leave important roles unfilled

in uncertain situations.

4.2 Strategic Capacity Planning

The Uttar Pradesh state government transformed the Maha Kumbh Nagar into a temporary city, operating for four months. This logistical and strategic effort was carefully managed to meet the needs of pilgrims, dignitaries, and government officials. The state prioritized key infrastructure and services such as security, healthcare, accommodations, transportation, and sanitation to ensure attendee safety. The temporary settlement area was expanded to 4,000 hectares, up from 3,200 hectares during the 2019 Kumbh, to handle the large influx of visitors (Iyer, 2025). Infrastructure improvements were crucial for managing the crowds, including the renovation of 92 roads, beautification of 17 main roads, construction of 30 pontoon bridges using 3308 pontoons, installation of 800 multilingual signs for navigation, and the placement of 2,69,000 checkered plates to create walkways in the mela area. Large-scale temporary settlement units, including luxury options, were set up for attendees (Ministry of Culture, 2025).

Large-scale waste management efforts play a crucial role in sanitation and hygiene planning at the event. There were 10,200 sanitation workers and 1,800 Ganga Seva Doots (who were deployed along the banks of ghats to ensure cleanliness and safety throughout the entire mela period) on key bathing days (Table 2). The capacity was later increased to 15,000 sanitation workers and 2,500 Ganga Seva Doots. Over 150,000 movable sanitation units, 20,000 trash bins, and 37.75 million liner bags were installed to support waste collection and disposal (Ministry of Information & Broadcasting, 2025).

4.3 Security and surveillance system

Security and surveillance systems were essential for smoothly managing the large influx of attendees expected at Maha Kumbh 2025 through technological interventions and infrastructural preparations. Layered protection was provided from the external security perimeter to the core zone; a comprehensive security framework was deployed, consisting of a seven-tier security system as shown in Figure 1 (The Times of India, 2025). Intensive inspections of restaurants, street vendors, unauthorized settlements, and hotels, along with thorough search operations in Prayagraj and neighboring districts, were part of a multi-layered approach. Vehicle entry into the mela area and Prayagraj was controlled according to prescribed norms, with unlicensed vehicles being restricted. The security measures included deploying over 50,000 security personnel, including paramilitary forces, more than 10,000 police officers, Central Armed Police Forces (CAPF), Provincial Armed Constabulary (PAC), National Disaster Response Force (NDRF), and bomb disposal squads. Additionally, 14,000 home guards were stationed, along with other security forces. The Prayagraj police enhanced infrastructural facilities comprising 8 zones, 18 security divisions, 23 security checkpoints, 13 temporary police stations, and 57 fixed police posts. The Central Reserve Police Force (CRPF) employed technology-driven methods for navigation, assistance, and monitoring of attendees at mela grounds, ghats, and major access routes.

AI-powered crowd-density surveillance systems were deployed at key locations with the involvement of over 340 experts. 2700 CCTV cameras with an AI-driven framework were implemented for real-time monitoring to detect potential threats, and timely actions were taken by the authorities. Drones were deployed to conduct aerial surveillance featuring anti-drone measures with tethered drones. Facial recognition technology was used to enhance safety at gateways. Underwater drones were employed for surveillance beneath the river for the first time, especially in the Triveni Sangam area. Drones were equipped with high-end technology designed to operate at depths of up to 100 meters and function efficiently in low-light conditions, providing precise details about suspicious underwater activity. For round-the-clock river monitoring, sonar systems were also integrated. The integrated command center (ICC) serves as the focal point for rapid decision-making, information flow, and timely interventions during emergencies (Ministry of Culture, 2025). The emergency helpline number '1920' ensures a comprehensive emergency response system throughout the event. The main focuses for the security and monitoring framework included underwater surveillance, cybersecurity, river safety, lost and found centers, emergency response, disaster management, and infrastructure development.

4.4 Understanding Crowd Behaviour

In large gatherings, one of the key aspects is understanding the behavior patterns of participants. Individual behavior in a crowd sometimes reflects the cues of others. People within the group may act differently than if they were alone. Crowd psychology studies the collective behavior of people in large gatherings. It is crucial

for security personnel to understand crowd psychology to manage different types of crowds effectively (Sidhu, 2016). Exploring how social-psychological factors influence mass gatherings is possible through the social identity approach, which includes social identity theory (Tajfel and Turner, 1979) and self-categorization theory (Turner et al., 1987). This approach suggests that people's self-definition involves viewing their personal identity as unique and their membership in social groups as social identities. These social identities serve as a way to categorize social groups into the self and others (Turner et al., 1994). Psychological changes occur when individuals see themselves and others as part of a social group (Hopkins and Reicher, 2016).

Individuals exhibit a shift in cognitive processes related to their personal ideologies, acting in accordance with shared values and norms as they adopt their group's beliefs (Turner et al., 1994; Hopkins and Reicher, 2017; Reicher, 2012). Attendees seek agreement, trust, support, and respect from their fellow group members as a result of social identification (Reicher, 2012). An individual's behavior is supported by their social identity, as they see themselves as part of the group (Hopkins and Reicher, 2017). Social psychology shows that these cognitive and relational changes are connected to crowd behaviors at large gatherings (Hopkins and Reicher, 2020). According to the National Disaster Management Authority (NDMA, 2014), the socially unacceptable actions of a few in a crowd can lead to more followers. Extended waits in worship venues may cause some attendees to climb over barriers, which could influence others to do the same, creating bottlenecks elsewhere. Therefore, it is important to identify and isolate disruptive participants.

Timely measures should be implemented with tact and firmness, avoiding unnecessary attention from the public, which can occur when force is used. A tragic stampede occurred on January 29, 2025, at Prayag Kumbh Mela during Mauni Amavasya, at the second shahi snan/amrit snana on the bathing ground. Because of the large influx of devotees, chaos ensued, leading to a stampede. When the barriers collapsed, pilgrims pushed against the barricades and tried to find alternative exits, resulting in casualties and injuries. This created severe challenges for crowd control. Poorly designed or improperly executed safety measures can increase the risk of such incidents rather than reduce them. The border venue should also receive special attention, and the moving crowd in that area should be carefully monitored, as these locations are vulnerable to crowd-related incidents.

4.5 Transportation Plan and Traffic Management

Considering available parking, transportation infrastructure, and traffic flow is vital for event site selection, emergency evacuation, and crowd control. Transportation and traffic management help reduce the impact of unregulated pedestrian and vehicular movement (Institute of Land and Disaster Management, 2025). Significant improvements have been made in crowd control systems and rail transport to accommodate a large number of attendees during the Mela period. For high-demand routes with over 1000 travelers, special trains were arranged to Prayagraj from various regions of India to streamline railway operations. Waiting areas were managed to prevent overcrowding. Additionally, 64 new Automated Ticket Vending Machines (ATMs) were installed at major railway stations to ensure efficient ticketing.

Police announcements informed passengers about the safe boarding procedures. Information booths and inquiry counters were improved at major railway terminals to assist pilgrims. Crowd density was monitored using advanced AI-based predictive modeling to prevent stampedes, and high-resolution CCTV cameras were installed for real-time monitoring across railway stations. Foot-over bridges (FOBs), improved lighting, and digital signboards at railway stations were built for better navigation and to ease passenger movement. The Indian Railways app services and digital ticketing were upgraded with emergency services information and real-time train tracking. These measures ensured safe, smooth, and organized rail travel for the large number of pilgrims attending the event.

4.6 Stakeholders' Collaboration

Crowd management is an integrated practice. The seamless implementation of crowd management strategies at mass gathering events depends on cooperation and communication among all stakeholders (Martella et al., 2017). Multiple agencies, including the police, the IT department, health, transportation, fire and rescue services, the protocol department, the National Disaster Response Force (NDRF), the Central Reserve Police Force (CRPF), municipal authorities, and the Prayagraj Mela Authority, work tirelessly to manage public health, infrastructure, security, and crowd control. A predefined response protocol and a well-coordinated communication network improve operational efficiency and reduce vulnerabilities in emergencies.

Coordination between private stakeholders, government agencies, and non-governmental organizations strengthens contingency planning.

4.7 Risk Assessment, Preparedness and Planning

Event coordinators should identify possible risks and causes of disasters. They must consider past incidents, pandemic situations, pressure points, bridge collapses, terrorist attacks, road accidents, drowning, and others. After identifying threats, they need to assess the risk, including the likelihood of each cause, its potential effects and severity, the warning time for visitors, and the duration of the danger. The following hazard types, likelihoods, and impact categories help ensure preparedness, safety, and effective use of resources (Table 3).

4.8 Innovation based on past Kumbh Mela events

Previous Kumbh Mela events serve as a strong foundation for crowd management in the 2025 Maha Kumbh Mela. Careful planning ensured the event was free from power outages. The installation of 2000 solar hybrid lights, compared to 70,000 streetlights, allowed lights to charge via solar power and electricity. Light-sensing auto switches turned lights on and off based on sunlight and also used electricity as a backup during foggy conditions. In 2019, these installations made the Kumbh a significant challenge; even during power cuts, the mela area remained illuminated. That year, short circuits posed a major risk, so Miniature Circuit Breakers (MCBs) were installed. To prevent exposed or naked wires, all wiring was enclosed in pipes this time. All electrical assets were geo-tagged for efficient tracking. Faults were quickly identified with QR codes and geotagging, which were also used for lost and found purposes, allowing people to send photos of electrical points, scan locations, and navigate back.

5. DISCUSSION

The study showed that there was rigorous planning and management during Maha Kumbh Mela 2025. Prayagraj Mela Authority and all other agencies involved in organizing and managing the large religious event successfully oversaw the event, ensuring it was safe, secure, convenient, and efficient. Previous studies focused on Kumbh Mela, and according to the Institute of Land and Disaster Management (2025), the planning and management of Maha Kumbh Mela was recognized as one of the wonders of modern-day management of large-scale religious gatherings. In many ways, the 4,000-hectare Mela township was not dirty; necessary infrastructure was in place to handle the large crowds. About 10,200 sanitation workers worked around the clock to keep the area clean. The lost and found center played a key role in finding missing people and helping them reunite with their families.

Some shortfalls were addressed to ensure emergency channels remained clear for security officers and ambulances to respond quickly during security emergencies. Improved coordination among stakeholders guarantees a more efficient response during unforeseen contingencies. Enhancing coordination between agencies will lead to faster and more effective emergency responses. Fire safety measures and regular inspections should be implemented to identify and eliminate fire hazards before accidents happen. Bridges were reinforced with non-slip surfaces and durable materials to ensure unobstructed movement. Weak structures were fortified to withstand heavy foot traffic and severe weather conditions. To reduce congestion at entrances and transportation hubs, pre-announced sequences should be used. AI-powered density assessment can assist authorities in optimizing practices and preventing dangerous bottlenecks. Increased camera capabilities help detect unusual crowd movements and potential hazards in high-traffic areas. Strengthening the integration of modern technologies will improve management at the continuously expanding Kumbh Mela in future years. As demonstrated by the case of Hajj, various management strategies implemented in recent years, such as scanners, sensor devices, smart ID cards, real-time monitoring via mobile apps, emergency services, and other emerging technologies, have proven effective in managing mass religious gatherings (Yamin, 2019).

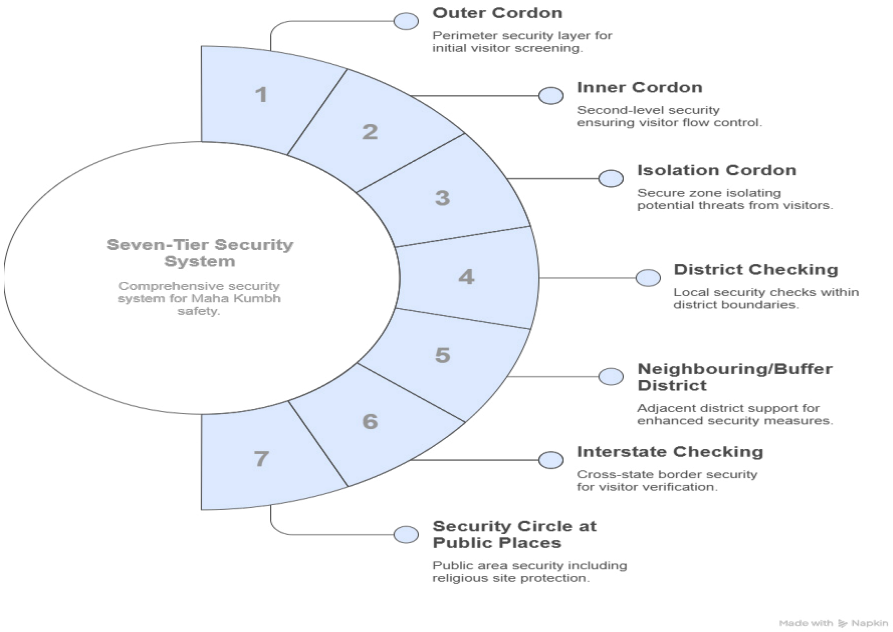

Fig 1: *Seven layered security system*

Table 1: *Kumbh Mela Locations*

Location	State	River
Haridwar	Uttarakhand	Ganges
Ujjain	Madhya Pradesh	Shipra
Nashik	Maharashtra	Godavari
Prayagraj	Uttar Pradesh	Ganges, Yamuna, Sarasvati

Table 2: *Major Bathing Occasions, as witnessed in Kumbh Mela (Prayagraj), 2025*

Date	Bathing Occasion	Number of Devotees taking a dip (Approx.)
January 13, 2025	Paush Purnima	1.5 crore
January 14, 2025	Makar Sankranti (First Shahi Snan)	3.5 crore
January 29, 2025	Mauni Amavasya (Second Shahi Snan)	5 crore
February 3, 2025	Basant Panchami (Third Shahi Snan)	2.33 crore
February 12, 2025	Maghi Purnima	2 crore
February 26, 2025	Maha Shivratri	1.3 crore

Sources: *Ministry of Culture 2025 report*

Table 3: *Hazard type, risk likelihood categories and their impact*

S.No.	Hazard Type	Risk Likelihood categories	Impact
1	Chemical and Gas Leaks	Critical	Improbable
2	Terrorist Attacks, Bridge Collapse	Catastrophic	Rare
3	Road Accident	Negligible	Occasional
4	Food Poisoning, Heat Stroke	Marginal	Occasional
5	Boat Accidents, Drowning	Critical	Occasional
6	Fire Hazards	Catastrophic	Occasional
7	Epidemic Outbreaks	Marginal	Probable
8	Electrocution, Environmental Degradation	Critical	Probable
9	Stampedes	Catastrophic	Probable
10	Dehydration, Vector borne disease	Marginal	Probable
11	Water pollution, Air pollution	Critical	Probable

Sources: *Institute of Land and Disaster Management (ILDM) report*

Table 4: *Statistics of Maha Kumbh Mela 2025*

Category	Statistics
Pilgrims	660 million
Fair Area	4,000 hectares
Temporary Roads	2,69,000 Checkered plates
Pontoon Bridges	30 bridges, 3,308 pontoons
Road Infrastructure	92 renovated, 17 beautified
AI-Powered Cameras	2,700
Security Personnel	50,000
Movable Sanitation Infrastructure	1,50,000
Sanitation Workers	10,000

6. CONCLUSION

The Maha Kumbh Mela showcased crowd management using innovative technology, focusing on safety, security, and a unique mix of tools. AI-powered analytics, drone surveillance, CCTV networks, and well-trained security personnel help control and reduce risks before they escalate. The event needed coordination among stakeholders, a strong emergency response system, and advanced surveillance. Despite careful planning, some issues appeared. Weaknesses in temporary structures raised safety concerns, while overcrowding on bridges caused flow disruptions. Critical vulnerabilities like open gas cylinders, limited exit routes, and exposed electrical wiring highlighted areas needing improvement. Even with AI-driven crowd monitoring, designated entry and exit points, and green corridors, the large crowds often exceeded expected numbers. The key challenge in managing crowds at such a massive event is accurately assessing attendee numbers (Kanaujiya & Tiwari, 2022). The Maha Kumbh Mela followed clear standard operating procedures (SOPs), used AI technology, conducted mock drills, and maintained continuous monitoring to improve strategies and address issues effectively. Specialized teams from the National Disaster Management Authority, security personnel, surveillance systems, and enhanced security standards for large events set this Kumbh apart from previous ones. What made Maha Kumbh Mela 2025 stand out was its ability to adapt quickly in real time. Well-established SOPs, mock drills, and ongoing monitoring ensured that adjustments helped resolve problems

efficiently. These strategies, along with the efforts of specialized teams and advanced surveillance, make future large-scale events safer and more organized. Recommendations from Maha Kumbh 2025 can guide upcoming events in planning and executing crowd management strategies. By strengthening infrastructure, integrating technology, and improving safety measures, the future Maha Kumbh Mela aims to provide a divine experience while ensuring safety, security, and a memorable event.

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Human Ethics and Consent to Participate

The study did not involve any clinical interventions or experiments requiring formal ethical approval or participant consent, as it was based solely on analysis and literature review.

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