

# Crowd Management and Strategies for Security and Surveillance During the Large Mass Gathering Events: The Prayagraj Kumbh Mela 2019 Experience

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**Abstract** The Kumbh Mela is the largest religious and spiritual mass gatherings on the Earth. In this way, it remains a source of fascination for vast numbers of Hindus throughout the world. Around 240 million pilgrims participated during Kumbh Mela 2019. The Crowd management and the strategy for Security and surveillance have become a big challenge for such huge gatherings. This paper tries to find out the various risk factors and its management. It examines the role and responsibilities of various stakeholders in crowd management. Despite of some difficulties like lack of knowledge of number of people, crowd psychology and its behaviour pattern, this paper provides a comprehensive approach for risk analysis, preparedness, management and mitigation. The purpose is to make spiritual mass gathering events incidence free and enhance user experience by applying design thinking approach. Although this paper tried to cover all the aspects of crowd management and strategies for security and surveillance during mass gathering events, still many more approaches are there which can be further explored. The mega tent city that accommodates nearly millions of pilgrims in the river bed is significant not only for India, but also for mass gathering research at international level to draw policy. This provides the multifunctional issues to study the mega crowd events. This provides the

opportunity to generate the field level evidence and document base for disaster management.

**Keywords** Crowd management · Surveillance · Security · Mass gathering · Kumbh Mela

## Introduction

Kumbh Mela is the largest congregation of people anywhere in the world at a given time [1]. There are huge pedestrian's movements in form of crowd during Mela period. Managing the movement of people in a hassle-free manner, managing crowds on peak days, ensuring the safety and security of pilgrims, and effective crowd management planning, should be the key focus areas to ensure an incident-free mass gathering events. Large-scale human activities in the form of mass gathering event have become more frequent especially massive entertainment events, religious gatherings, sports events, political rallies, product promotions, etc. Crowd safety, security and surveillance have become a critical and challenging [2]. During Kumbh Mela (the festivals of the sacred Pitcher), pilgrims take bath or take a dip in a sacred river. Devotees believe that by bathing in the river, one is freed from sins liberating her/him from the cycle of birth and death. Millions of people reach the place without any invitation. The congregation includes ascetics, saints, sadhus, *kalpavasis* (who reside during the whole mela period and live simple life) and visitors. The festival is held at Prayagraj (Allahabad), Haridwar, Ujjain and Nasik every four years by rotation and is attended by millions of people irrespective of caste, creed or gender. This mass gathering event encapsulates the science of astronomy, astrology, spirituality, ritualistic traditions, and social and cultural customs and practices,

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making it extremely rich in knowledge. As it is held in four different cities in India, it involves different social and cultural activities, making this a culturally diverse festival. A mass gathering is when more than a specified number of persons at a specific location for a specific purpose gather for a defined period [3]. During the mass gathering, pedestrian mob starts behaving in unpredictable manner under the influence of psychological and other relevant factors which becomes difficult to manage according to the norms of traffic engineering characteristics and is termed as pedestrian crowd. Characteristics of crowd also play very important role. Conventional challenges in managing the security and safety of pilgrims include crowd management (control, channeling and diversion), planning and managing peak days (day of occasion), proactive disaster management planning, and effective response to all emergencies and disasters. A mixture of high crowd density, restricted points of access, poor crowd control, and lack of complete information of the areas and activities can lead to situations of disaster in form of stampede, etc [4]. Crowd behaviour, structural collapse, rumours, no clear evacuation plan, no proper signage, lack of coordination between different stakeholders, under capacity of area, etc., are major reasons for crowd disasters. The Kumbh Mela, the Hajj and the Shia procession to Karbala are some of the biggest mass gatherings of humanity. Kumbh Mela is considered as the largest religious gathering and involves the pilgrimage of estimated more than 100 million Hindus to a sacred river in a span of one month. There are three traditional *Shahi snan* done by *Akharas* on *Makar Sankranti*, *Mauni Amavasya* and *Basant Panchami* and six peak days on *Makar Sankranti*, *Paush purnima*, *Mauni Amavasya*, *Basant Panchami*, *Maghi purnima* and *Maha Shivratri* during Kumbh Mela. Due to the huge crowd, risk assessment, analysis and preparedness are very important to make incidence-free event. It also attracts the challenge of security and strategies of surveillance of people coming to the event by prioritizing the pilgrims or participants needs. It requires design thinking approach which involves prioritizing the consumer's needs above all else. It relies on observing, with empathy, how people interact with their environments, and employs an iterative, hands-on approach to creating innovative solutions.

### Religious and Spiritual Significance of Kumbh Mela

The Kumbh Mela is a religious Hindu festival that has been celebrated for hundreds of years [5]. The Kumbh Mela provides a window to Hinduism. It presents a microcosm of the spiritualism at the level of both thoughts and practices. Over the centuries, it has attracted millions from across the

world, irrespective of their faith, caste, religion and gender [6]. Philosophers, saints, gurus, preachers and scholars from across India and abroad, *mahant*, ascetics, sadhus and saints from different orders and sects in India congregate here and participate in spiritual discourses and debates, sharing their wisdom, knowledge and experiences in large gatherings. *Tirth* or the pilgrimage has its significance in all religions. To Muslims, a pilgrimage to Mecca and Medina brings great spiritual benefits, to Christians or Jews a pilgrimage to Jerusalem is a life time's dream. In Hinduism, the concept of *Tirth* grew from the Vedic reverence of rivers in the hymn, the *nadistuti*, associated with water. It is believed that the riverside *tirths* absorb the sins and sorrows of the countless pilgrims. The flowing water of rivers at Kumbh, Ganga (Prayagraj and Haridwar), Godavari (Nasik), and *Kshipra* (Ujjain) is believed to acquire divine qualities because of their unique astrological planetary positions during the Kumbh period. During period of Kumbh Mela, *kalpwasis*, saints, preachers reside and various social organizations are established. Tents were made for temporary stay of around 2 million pilgrims. The six peak days were spread across 49 days of the Kumbh Mela 2019. The Mauni Amavasya is the highest crowded event during Kumbh Mela in which around 50 million pilgrims participated.

### Materials and Methods

We searched various databases for journals with key words like Kumbh Mela, mass gathering, crowd management, pilgrimage, security, surveillance, spiritual gathering, stampede, crowd simulation, etc. We explored Google scholar, PubMed, ReserchGate, etc., and focused only on the peer reviewed literature. Earlier Kumbh Mela reports published by Prayagraj Mela Authority and reports published by various departments studied for this research. News related to Kumbh Mela, Magh mela and mass gatherings were used as information and data sources.

### Results and Discussion

#### Causes for Stampedes and Disasters

During mass gathering events, types of crowd play a very important role in planning for crowd management. In Kumbh Mela, mostly pilgrims, saints, preachers and tourists participate and they come by using rail, bus, airways, and private vehicle or by pedestrian movement. They come by their own self-motivation. Based on the earlier experiences, the causes of stampedes and disasters can be classified into structural collapse, fire accident and behaviour

of crowd, security, no clear evacuation plan, and lack of coordination between stakeholders and less known and understanding of emergency plan of traffic diversion to the enforcement agency. Structural collapse occurs due to collapse of temporary structure, bridges, barricades on the roads, etc. Encroachment on the exit routes reduces the carrying capacity of people. Sloped gradient, Slippery or muddy roads also affects the smooth pedestrian movements. In a mass gathering events, fire incidence, non-availability of fire tenders or extinguishers, illegal and unsafe electrical connections, electricity cut in gathering area, short circuit and building and fire code violations causes the stampede-like situations [7]. More than anticipated crowd, no proper circulation area, more inflow of people than outflow, limited or no holding area on the route, closed exit, no classification of crowd for sitting arrangement, uncontrolled and unregulated parking of vehicles, cross movements from different direction, no or very less communication through public address system regarding arrangement or programs to public, celebrity or higher dignitaries movement also are main reasons for stampedes or disasters. Crowd behaviour during mass gathering movements affects the flow of pedestrian movements. In Kumbh Mela, majority of public comes from the rural areas. They come with the whole family having their belongings and food items. Sometimes they come in small groups and they never want to leave the group because of fear of being lost. This changes their behaviour during pedestrian movements because they were trained in such a way that they have to follow the leader and walk behind him. They do not want to leave the group so when there is some traffic diversion at cross points all the group members' together move and normal speed increases which may causes the stampede-like situations. The triggers of human stampedes can be simple accident, an intentional act or even a rumour can trigger a crowd disturbance and change the crowd psychology. Crowd attempts to forcefully enter the venue even after no availability of seats in closed venues. There are rush during free distribution of gifts, attraction of celebrity to take glimpse, collecting to perform some spiritual activities at particular span of time, entering from the exit routes, delay in start of event or last minute change in program, rumours regarding any small accidents in mass gathering events. Lack of proper planning and feedback from multi-stakeholders, under deployment of security personnel, lack of in-depth training and briefing regarding crowd control, behaviour, emergency plan and use of new technology affect the capacity of security personnel to face the challenge in case of disaster. Selection of strategic locations for installations of CCTV and Public address system enhances the capacity for better surveillance management. Lack of coordination and communication gaps between organizer, government

functionaries and other stakeholders affects the immediate response to the incidence. According to the administrative report of the mela authority, the year-wise inflow of pilgrims in Kumbh Mela and Ardh Kumbh Mela is given below. There is remarkable increasing pattern of inflow of pilgrims in last two decades as shown in Fig. 1.

### Capacity Assessment and Planning

This can be classified into long- and short-term perspective. Short-term capacity planning is temporary and event-oriented development in nature-like development of parking, holding areas, temporary public accommodation, facilities for food, toilet and water on the route and assessment of requirement of security personnel, etc., while long-term capacity planning includes permanent infrastructure development which should depend on popularity, periodicity of event, weather, terrain, local population-like construction of bridges, broadening of roads, sewage treatment plant for solid waste management, development of traffic junctions, electrification of roads, development of multiple routes, shuttle buses, etc. Location of the event sites also plays a very important role, and it requires planning according to that. Kumbh mela is developed as a separate city, and all functional machineries are established temporarily. As per the police reports submitted, 01 Senior Superintendent of Police (SSP), 01 Superintendent of Police (SP), 13 Additional Superintendent of Police (ASP), 50 Deputy Superintendent of Police (DSP), 8469 civil police (6976 male police, 478 female police, 292 traffic police, 178 mounted police, 147 from transport department, 243 local intelligent unit and 155 jal (water) police), 6500 home guards, 400 *prantiya rakshak dal*, 22 company *Pradeshik* Armed constabulary (PAC), 01 Company State Disaster Relief Force (SDRF), 37 Company Central Armed Police Force (CAPF), 03 Company National Disaster Relief Force (NDRF), 07 teams of Bomb Detection and disposal squad (BDDS), 02 teams for Anti-Terrorist Attack (ATS), 02 teams of special task force (STF), 01 team of National Security Guard (NSG) and 15 Spotters were deployed for Kumbh Mela area. 1100 body protector, 1100

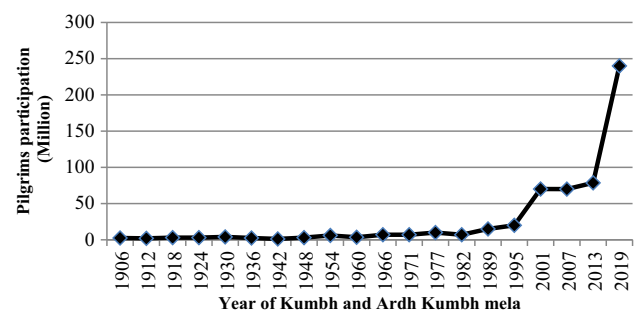


Fig. 1 Pilgrim's participation in Kumbh Mela and Ardh Kumbh mela

polycarbonated shield, 1500 polycarbonated cane, 1100 helmet, 20 digital cameras, 100 short- and long-range binocular, and 17 dog squad were used by the civil police in Kumbh mela area. This was based on the earlier experiences and expected pilgrim's participation in Kumbh mela 2019. Since the police forces were deployed from various parts of country which necessitated training for all officers and personnel before deployment. The aim of training was to sensitizing the forces towards the nuances of the Mela, key concerns of pilgrims and action plan during incidents and emergencies. It also focused on behavioural aspects of training to make them sensitive towards pilgrims. Trainings were organized for all deployed police personnel. This included first responder training, security plan sensitization, traffic plan awareness, radio communications training, disaster management standard operating procedures, coordination, and behavioural change. Other line departments establish their functional office in each sector.

### Security and Surveillance System

Security and surveillance systems are required to be strengthened through technological interventions such as aerial surveillance (drones), enhancements in ground surveillance, widespread anti-sabotage checks, and explosive detection systems. Real-time intelligence analysis and dissemination systems need to be deployed to gather and provide intelligence to ground personnel from various agencies engaged in ensuring the security and safety of pilgrims. Initiatives to aid the navigation of pilgrims in a simple and effective manner can be taken like numbering of main routes, colour coding of parking lots, coloured strips on pedestrian routes, variable message display (VMD) boards, and maps and signs to channelize vehicular traffic. Video analytics can be used for crowd management and detection of unidirectional/bi-directional/ wrong way movements/restricted area movement and crowd density calculation at important locations. This can help in head counting to assess the crowd density on the particular route and facilitate to take decision for traffic diversion or for activating holding areas [8]. If the location of mass gathering event is being organized in open areas, it is better to divide the area in zones and sectors. It helps in diverting the crowd from populated sector to less populated sector. It also helps in emergency to evacuate the crowd from problem area. Proper circulation area should be given near the area where event is being organized. It helps in closer supervision of flow of crowd. There was integration of dedicated helpline number '1920' and UP Dial 100 (now Dial 112) services through Integrated Command and Control Centre (ICCC) for real-time and effective reporting of any emergencies and disasters that enabled the

emergency responders to reach the incident site within a short time. Effective coordination was ensured between the Kumbh Mela Police, Prayagraj District Police and Railway Police, in addition to other specialized forces such as Anti-terrorism Squad (ATS), Special Task Force (STF), Special Intelligence, National Security Guard (NSG), Intelligence Bureau (IB), National Technical Research Organization (NTRO), NDRF and Central Industrial Security Force (CISF) for security planning and comprehensive plan for deployment of forces, deployment of technology interventions and responding to incidents. The key focus areas for security and surveillance strategy were surveillance, water and fire safety, communications management, disaster management, traffic management, crowd management and infrastructure development.

### Crowd Behaviour and Psychology

The basic element of mass gathering event planning is to understand the behaviour of visitors or participants. Individual behaviour in a crowd is sometimes influenced by the behaviour of others. The individuals within crowd may act differently than if they were on their own. This is largely determined by the type of event whether it is religious, youth festival, sports event, music concerts, political gatherings, particular specific day and time event based on astrology, etc. Political (instability of government, internal conflicts within state, terrorist activities, violence affected areas, etc.) and geographical conditions (open or closed space, temporary or permanent, plain or hilly terrain, across the river course, season, etc.) of venue also affect the crowd management planning for security and surveillance. Based on the prior experiences, knowledge and incidences one should attempt to determine the type of crowd expected, i.e. age, social structure, gender, local, visitors coming by rail, bus, private vehicle, airways or pedestrian, and their estimated numbers. Promotion of programs by media or organizers or sometimes free rail or bus service facilities attracts people a lot, and it should also take into consideration for estimation of people. For effective crowd management, the motives of the visitors should be identified whether it is political, economics, spiritual, religious, and entertainment, social, etc. In case of Kumbh mela, the visitors mainly consist of saints, *kalpwais* (who stays during whole Kumbh mela period) mostly with rural background, tourists within country and across the world, etc. Mostly people come with a single aim to take a dip in river and return back. On peak days of bathing, huge crowd tries to reach nearest to the *Sangam* (the confluence of three rivers, i.e. Ganga, Yamuna and mystical Saraswati) to take a dip during particular period of time. The people come in small groups with one leader with all their belongingness. They follow the leader and move according to him because

due to huge crowd there is always a fear of being lost. Unlawful actions of a few people can result in larger numbers following them. There is also need to establish the lost and found system in each sector with LED screen displaying in each sectors. This should be connected with the state-of-the-art communication system. Major locations should be geo-mapped and plotted on Google maps to facilitate the security personnel and visitors to easily find out.

### Crowd Control, Traffic Management and Comprehensive Mobility Plan (CMP)

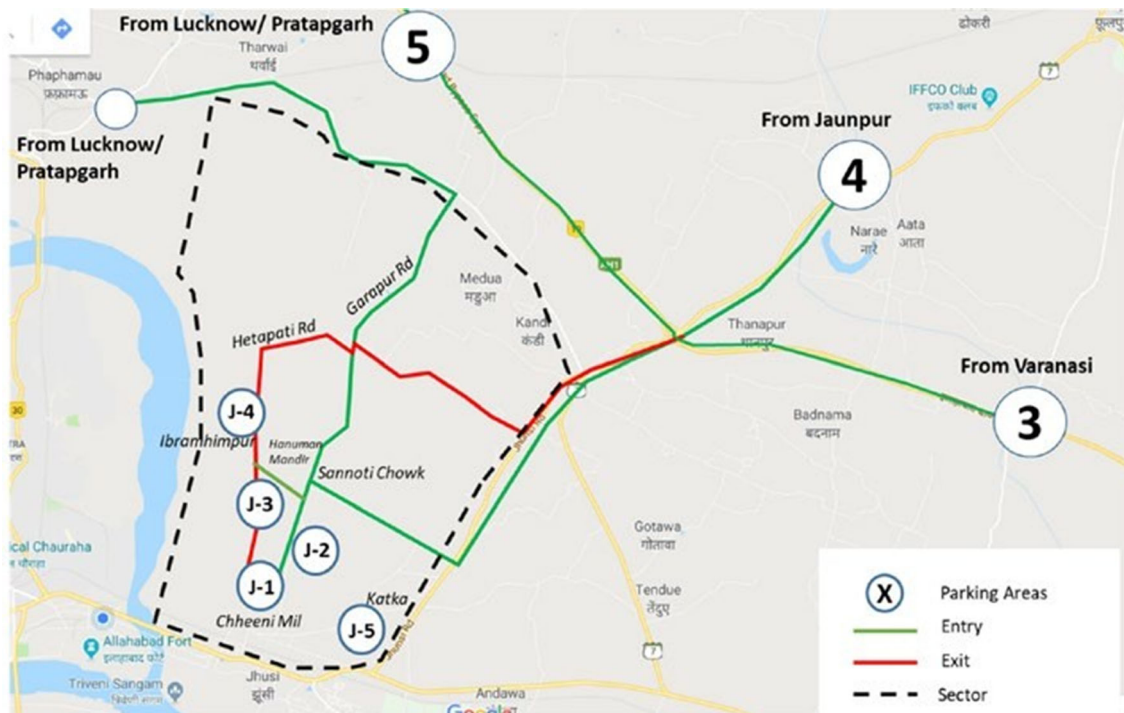
The guiding principal for crowd control should be managing demand and supply gap through controlling the crowd inflow, regulating the crowd at the venue and controlling the outflow. In order to understand demand, first we have to understand the crowd arrival patterns (rail, bus, airways, pedestrian, private vehicle, etc.), past historical numbers if event is regularly organised, growing popularity of event through media campaign, spiritual significance, type of visitors, mass arrival time span creating peak for huge gathering ( seasons, particular time in a day, weekends, festival, holidays, etc.), advance booking of tickets, public transport time tables, sun and moon planetary position in case of Hindus and Muslims for religious gathering, respectively. Supply can be assessed based on the capacity of venue, seating capacity, length of river bank for bathing and circulation area, worships or prayers possible per hour, capacity of parking and holding areas, road carrying capacity towards venue, public accommodation facility in case of event organised for long period, availability of basic minimum facilities like water supply and toilets, etc [9]. If demand is high, then supply input control system should get activated. Number of participants can be restricted by mandatory registration process, promoting off peak days by giving discounts, separate queues for advances booking, restrictions on celebrity or any VIP movement on peak days, demotivating private vehicle by ensuring enough availability of public transport. Some guiding principles can be used for managing queues.

1. The perceptions of crowd waiting in queues are important. We need to continuously communicate to the people in queues like about distance of venue from queue, waiting period, overcrowding at venue, etc. Perceptions management cannot be overlooked.
2. There is need to find out estimated waiting time at holding areas and queues.
3. Signages play a very important role in crowd control.
4. Promotion of online services to decentralise the crowd.
5. Special attention towards old aged, women and physically disabled people.

6. Modify visitor arrival behaviour by informing non-peak hours.
7. Crowd control staff should be uniformly dressed for high visibility
8. Green corridor needs to be identified for emergency health services.
9. Monitoring crowd by using CCTV and drone technology through control centre.

For crowd management, a circulation area for pedestrian movement, public and private transport movement, etc., should be identified. Old age and physically challenged people can be exempted for movement by dedicated e-rickshaw in circulation area. The circulation area should be properly planned, and vehicle moment should be restricted. In each sector, parking and holding areas should be provided. During Kumbh Mela 2019, pilgrims utilized the various modes of transport like public transport, intermediate public transport, private transport, pedestrian movement and pedestrian movement on water in mela area and outside area. Separate initiatives were planned with respect to peak days and non-peak days. The capacity of roads was enhanced by widening of roads and by constructing of alternate roads. The idea was to make the pilgrims movement unidirectional. The traffic plan from city area to Sangam area is given in Fig. 2 for Kumbh mela 2019. Parking lots were developed on the roadside leading towards mela area. It was planned in such a way so that people should walk very less. Basic minimum facilities were provided with CCTV cameras at parking areas. Traffic diversion plans were made with the coordination of adjoining districts and States. Holding areas and diversion schemes were proposed for pedestrians approaching the *Sangam*. The concept of unidirectional movement was followed in mela area to manage the crowd. The mobility plan for Kumbh mela 2019 was inclusive and geared to provide pilgrims an improved user experience on the basis of the following salient features.

- Integration of transportation modes for last mile connectivity (Rail, shuttle buses, e-rickshaw, etc.)
- Adequate physical infrastructure (Construction of fly-over, rail over bridge, rail under bridge, satellite parking areas, pontoon bridges, holding areas, etc.)
- Unidirectional movements of vehicles (avoiding intersecting movement of vehicles)
- Distribution of traffic across the mela area (Not all traffic moved towards *Sangam* area but diverted on different parts of mela by diverting traffic)
- Pedestrian prioritized planning (no vehicle zone during peak days)
- Focus on contingency planning (reserved parking areas and contingency routes)



**Fig. 2** The traffic management plan from City area to Sangam area during Kumbh Mela 2019 ( Source: Prayagraj Mela Authority)

This mobility plan was developed with the consultation of Administrative authorities (Prayagraj Mela Authority, Prayagraj District Administration, Municipal corporation), enforcing authorities (Prayagraj police department, Kumbh Mela police department, Transport department), Line department (Public works department, National highways authority of India, State bridge corporation, Municipal corporation) and supporting authorities (Health department, power corporation, *jal Nigam*, transport department). This resulted into 9 National highways widened, 9 ROB constructed, 22 pontoon bridges constructed, 95 parking areas and 300 people capacity Airport terminal developed. Prayagraj has nine railway stations which plays major role during Kumbh mela. The biggest challenge for railway stations was the peak day influx of pilgrims. Indian railways prepared a plan which included increasing the capacity of railway stations, running around 800 special trains, development of holding areas with basic amenities outside every functional railway station, unidirectional movement over bridges at stations, fixing signage boards, etc. During Kumbh mela, around 5500 buses were planned by the Uttar Pradesh state Road transport. Three Colour traffic scheme was planned during the crowd in mela area. It was to be implemented outside the mela areas by making traffic diversion.

### Stakeholder Participation

Organizers, law enforcement agencies, voluntary organization, non-government organization, welfare committees, etc., should encourage taking ownership in events for unity of purpose, faster decision or response, better coordination. They play a greater role non-policing activities like organizing queue, providing service to old age and physically challenged people, continuous communication and requesting to crowd for having patience and calm down in case of any problems. The roles and responsibilities of other stake holders should be clearly identified and inculcated into plan, but they should work under a unified control system. Crowd management is a collaborative practice. The successful management of a mass gathering event depends on the cooperation and communication between all stakeholders [10].

### Media Management

Providing actual information in very less time to media (electronic, print and social) helps to reduce/restrict the fake news circulation among masses. An officer should be identified to provide the authenticated information to media after any incidence, and he should be easily accessible to media personnel. He must have all the relevant information regarding event. Media helps in disseminating the actual information regarding any incidence, educate masses,

providing feedback of any activities and suggestions regarding any shortcomings in disaster management and relief measures.

### **Risk Assessment, Preparedness and Planning**

Potential threats and causes of disasters need to be identified. Planner for event management should consider the causes of the previous accidents if any, demography of the area, availability of resources, limitations, pressure points, possibilities of flood, pandemic situation, etc. After identifying the threats, risk should be assessed. It should include the probability of occurring of any incidence, its effects and severity, estimated time span of occurrence, etc. The following checkpoints can help to preparation of crowd management planning (Table 1).

### **Role of Information and Communication Technology (ICT) for Information Dissemination and Communication with Masses**

The review of the past incidences and disasters indicates that the lack of communication or no proper necessary communication with the masses increased the intensity of damages. The continuous addressing masses in queue through public address system increases the patience level. People get less panic and in cases of stampede they change their direction during movement. Proper communication regarding any incidence or disasters reduces curiosity of masses, and they do not do undesirable behaviour. It is very useful instrument to manage and organize crowd at public transport locations like railway station, bus station, airport, pre booking taxi stand, etc. Continuous providing information regarding traffic diversion, location of parking areas and its update being filled or vacant, distance of venue, time for starting of event, etc., helps the visitors get actual information. Proper information dissemination is also very necessary among various stake holders like event organizer, government officials, security personnel, voluntary organizations, media and local residents, etc. The Checklist is given below for visitors in Table 2. In 1954, a stampede occurred during Kumbh Mela in Prayagraj (Allahabad) in Uttar Pradesh, India. It was the main bathing day of *Mauni Amavasya* (New Moon), when the incident took place. During the festival, 4–5 million pilgrims had taken part that year, which was also the first Kumbh Mela after the Independence. According to the book *Law and Order in India*, over 500 were dead. Lack of proper information dissemination intensified the incidence. In 2013, during the Kumbh Mela, a stampede broke out at the railway station in Prayagraj (Allahabad), Uttar Pradesh, India, due to last minute change of platform of train and passengers started to run to catch the train which created chaos and stampede

over the rail over bridge (ROB) killing 36 people and many injured. Efficient functioning of command and control is single most important component of crowd management. Information and communication technologies enable to improve the crowd experience and crowd control [11]. The most common technologies include geographical information system (GIS), short messaging service (SMS), radio frequency identification (RFID) tags, drone, registration database survey, closed circuit television (CCTV), image processing, crowd simulation, using fog and cloud computing, etc [12]. Registration database should be deployed to capture demographic details (gender, age, and place, etc.) of the visitors, but it has its limitations when there is huge inflow with short span of time. Its success depends on the socioeconomic profile of visitors. The registration system can be installed at different routes. It helps to ascertain whether visitors have arrived at the venue in case of any unfortunate catastrophes. Online registration system for mass gathering event could help in finding out the arrival pattern. RFID tags and biometric smart cards help to track the exact number of visitors at various locations and can further enable better control of traffic flow along the route. CCTV should be deployed for surveillance and early detection of emergency. The feed of CCTV should be monitored at ICCC, and it should integrate with helpline numbers. The triggers and response system are given in Fig. 3. ICCC was the nerve centre during Kumbh Mela 2019. Its aim was to integrate the Mela area with the city area. It helped a lot to police department in maintaining law and order and crowd management through 1103 CCTV cameras installed at 310 strategic locations. These locations covered mela area, parking area, railway stations, solid waste management area and city area. The video feed received from the cameras deployed in mela area used for head count mapping, crowd pattern analysis, suspicion person identification, pilgrims assistance by display of *snan* (bathing) on screens, updating information on variable message display, identifying incoming and outgoing traffic in the city and mela area to avoid stampede, traffic management and traffic congestion pattern analysis, etc.

### **Impact of Pandemic COVID-19**

Corona virus disease 2019 (COVID-19) is a contagious disease caused by severe acute respiratory syndrome Corona virus 2 (SARS-CoV-2). The disease has its impact and spread worldwide. It warned the mass gathering event organizer to also address the issues related to diseases caused due to huge international and national movements of people. Hinduism is an ancient religion followed by over 1.1 billion people worldwide. This constitutes more than 15.1% of humanity [13]. Both foreign and Indian pilgrims participate the Kumbh Mela to attain the spiritual

**Table 1** Risk factors, their indicators and management

Sl. no.	Risk factors	Indicators and management
1	Fire protection	Number of fire stations, extinguishers and tenders and distance between them Average response time Average time for getting fire alarm or information from control centre to fire protection team Fire safety drills
2	Emergency health services	Number of Ambulances with Air ambulance Number of advanced life supply ambulances Trauma care facility Number of Medical personnel (Doctor, Para medical staff, etc.) Average response time Number of First aid kits availability Availability of life saving drugs, vaccines, oxygen cylinders, etc. Identification of dedicated Green corridor
3	Sanitation facilities	Dustbins availability and distance between two dustbins Toilets and urinals in proportion to visitors (separate for men and women) Timing of picking up garbage and sweeping of roads Approach to the venue and exit paths are safe and clean and encroachment free
4	Risk assessment of potential hazard conditions	Frequency of crowd Frequency of hazard occurrence, severity, difficulty of detection or control
5	Emergency evacuation	Availability of public address system Integrated command and control centre (ICCC) monitoring Response time in implementation of emergency exit plan Response time of implementation of traffic diversion scheme
6	General information	Signage Information regarding map of area having layout, location of stay, food, information kiosks, entry and exit points, holding areas, police stations, lost and found office, shopping areas, places of interest at venue, medical facilities, local transport, toilets, urinals, parking, peak days, non-peak days, etc., are available online and publicized and given to all security personnel Variable message display Clear guidelines for holding and releasing the visitors from holding areas All projects are timely done Contact details of event organizers and helpline numbers
7	Integrated command and control centre (ICCC)	ICCC getting feed from all CCTV installed Able to identify crowd density and its actual location Able to identify crowd velocity and its actual location Able to identify the cross pedestrian movements Properly guided in case of emergency to whom to be contacted Able to identify crowd density at holding areas to restrict uncontrolled flow movements Able to identify vehicle density at parking areas to trigger for the activation of the another parking location Drone monitoring for observing the overall crowd in the case the crowd spread is too big
8	Roles, responsibilities and training	Roles and responsibilities are clearly identified for officer, security personnel and various stakeholders Behavioural training are given to each security personnel and NGOs and other stakeholders are also trained for disaster processes



**Table 1** continued

Sl. no.	Risk factors	Indicators and management
10	Unidirectional movement	Timely mock drills and safety audits have done Ensured unidirectional movement on road, bridges, fly overs No cross movement or intersection of visitors at any locations
11	Coordination	Coordination between multiple department has been done Decisions taken are well documented and communicated In case of emergency, officers are designated for coordination Meeting with regular interval
12	Past incidences/disasters	Previous disasters and their causes are identified Possible disasters are identified
13	Documentation	Communication plan (having Key contacts) Site plan and master plan are documented Process of managing hazards Documentation of events for future

**Table 2** Checkpoints for the visitors

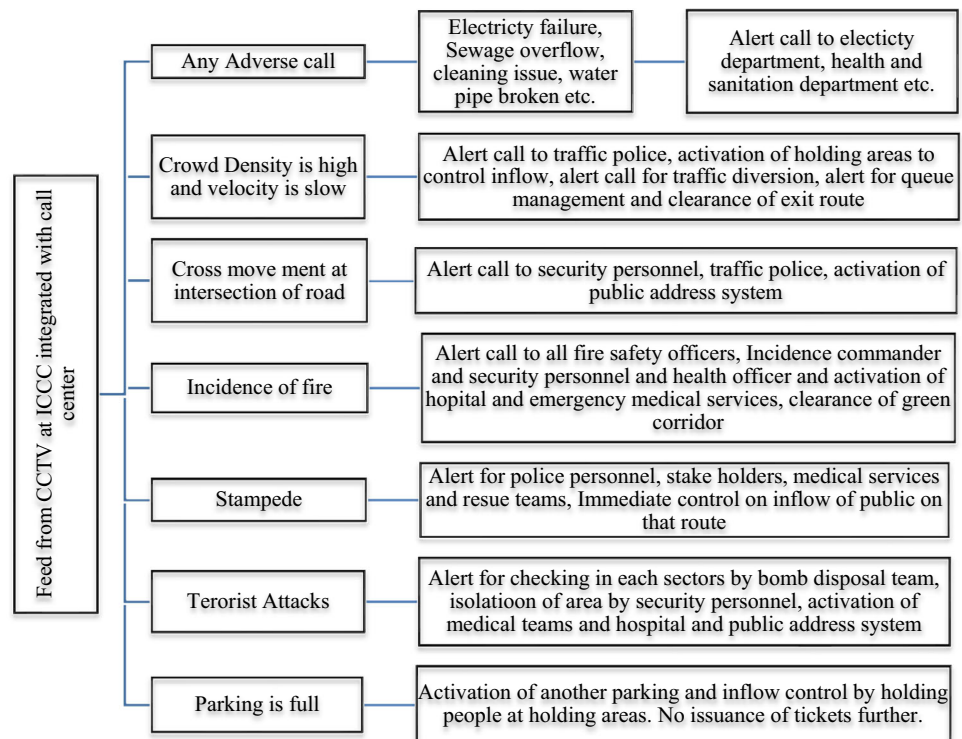
Serial no.	Instructions	Medium	Responsibility
1	Brief regarding venue and events, Maps and places, police, fire, Ambulance and helpline numbers, entry and exit points, emergency route	Video display, posters, pamphlets, announcements, publishing in newspapers much before event, online availability on event website	Event Organizer, Government machinery, Police
2	Briefing to media	Regarding events, programs, traffic diversion, Important contact numbers, helpline numbers, etc., by press conference	Event Organizer, Government machinery
3	Traffic diversion, Parking areas, Holding areas, Mode of transport, Restrictions in circulating areas, Exception of Physically challenged and old age people, route map	Signage, public announcement	Traffic police, security personal on duty point
4	Do and Don'ts and advisory	Video Display, announcements, pamphlets, posters, banners, online availability on event website	Event organizer

connectivity and spiritual knowledge. They are involved in early morning bath in the river, prayers, *yoga* (meditation), serving to self and others and listen to the saints during spiritual discourse. The religious mass gatherings attract people globally, and there is always a health risk like spreading of infectious and communicable diseases due to international connectivity, etc [14]. The Country-specific diseases have the potential to spread in other countries during movement of people from one place to another place during spiritual activities like Kumbh Mela, Hajj or any other sports activities like Olympic, etc. There is potential for the international spread of Middle East respiratory syndrome associated with mass gatherings and may cause pandemic like situations. In mass gathering events respiratory, faecal-oral, vector-borne, blood-borne and sexual modes of disease transmissions have been identified. During mass gathering events, there are lot of close interaction among people which necessitates the

preventive measure to contain the pandemic diseases. There is needed to make planning to restrict the number of people. The area of the event should be increased to accommodate the people with proper distancing. Sampling centres should be established, and it should be widely publicized that the persons having Covid 19 symptoms should not come. Vaccination or RTPCR test must make mandatory for entering into event area. Keeping the public health risks associated with the religious mass gathering event and growing concerns of pandemic Covid-19 disease, the following suggestions can be adopted.

- Wide publicity regarding Covid-19 protocol and preventive measures through electronic, print and social media.
- Announcement by religious leaders to follow the Covid-19 norms and restrict to themselves to come to the event of Covid-19 protocol.

**Fig. 3** Trigger and response system at ICCC



- Dedicated healthcare facilities
- Identifying to those social organizations which are having large crowds in the Kumbh mela so that focused attention can be given for compliance in case of spread of Covid-19 disease.
- Restrictions on entry of old age people and children.

## Conclusion

The actual assessment of visitors is the biggest limitations for the crowd management planning in largest mass gathering event. The registration of all visitors is not possible in case of event like Kumbh Mela where major segment of pilgrims is from lower socioeconomic profile with little awareness of internet. The particular location-oriented mass gathering event puts the limitation on venue management and crowd management because every visitors aspire to go to the main location of event like in Kumbh mela where circulation area at *sangam* (confluence of three rivers) is decided based on the course of river. Crowd simulation, image processing and RFID tags provide help in real-time assessment of crowd density at particular location but very costly for huge masses and having the possibility of image duplicity. The open ended venue like in Kumbh mela restricts the security and surveillance

management where the settlement is developed along the riverside. The increasing attraction towards the Kumbh mela has put up a great challenge of crowd and security management. In comparison of earlier Kumbh, Kumbh mela 2019 focused meticulously on safety, security and crowd management with the intervention of innovative approaches and technology. The concept of holding areas, satellite parking, ICCC, CCTV surveillance, and RFID tags were the new to the mela. The huge deployment of trained force made the Kumbh Mela big incidence free. The behaviour of Police forces was appreciated. The use of Drone and CCTV surveillance needs to be increased to better security, crowd and surveillance management. After the Covid-19 pandemic, the focus should be on restrictions of visitors on peak days [15]. Traditionally, government provides free of cost land, electricity, water supply and all other facilities during Kumbh mela. The government should make assessment to impose some token money for providing institutional facilities in future.

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#### Declarations

**Conflict of interest** The authors declare that they have no conflicts of interest.

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