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ENVIRONMENTAL MANAGEMENT IN MASS GATHERINGS

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Abstract:

A public event or mass gathering is basically is an event where thousands of people are gathered as attendees to the event. The populace depends upon the type of event and also its purpose. There are various challenges that usually come across while conducting the event which affects the environmental health and food safety, public health, quality of portable water, waste water treatment facilities, solid waste management, air pollution etc. this paper discusses the environmental management of public gatherings. It includes all the facilities that are available and could be implemented at social events like Kumbh Mela and other fairs, political rallies, sporting events, conferences, religious gatherings etc.

In this paper, we have accounted the governing factors which affect the environment adversely. Some measures are also mentioned which if implemented can make the management of resources efficient.

Key words: Environmental Management, Mass gatherings, Health, Sustainable Efforts

I. Introduction

A public event is an event in a certain place during a particular period of time for public attendance. Mass gatherings are typically assemblage of more than 1000 people at a particular place for certain duration. Mass gatherings may include sporting events, political rallies, concerts, fairs and festivals, conferences etc. Such events involves number of stakeholders including event organizers, tourism practitioners, policy makers, event volunteers, risk & emergency forces, security forces, emergency management, professional associates, community partners and relevant stakeholders with government administration emerging as the biggest contributors. The issues related to food, water, sanitation, air quality, physical and technical hazards, waste generation and management etc are key areas where strict and prompt actions are required. The paper has covered all the basic requirements and problems that can be encountered by mass attending of the events.

There are various roles & responsibilities while conducting any public event. Any public event begins as concept being proposed by any individual or organization. Firstly a pre event planning is done in which various issues are discussed like when or where the event will be held, type, number of audience interested, duration etc. But a basic and most important aspect is the effects that it can create on the environment.

Mass events may lengthen to different intervals. Some last for few hours like political speeches while other extends for one day or two like religious events or sporting events. The attendees also vary according to the purpose or popularity of the event. For example about 1000 spectators may be considered to have gathered for a political speech which can be doubled or tripled for any other function. A very common example of mass gathering can be taken of Kumbh Mela. An estimated 30 million people were gathered to bathe on Mauni Amavasya on 10 February 2013 during recent Maha Kumbh Mela in Allahabad, India.

1. Various Environmental Concern In Mass Gathering

Following are the environmental concern related to mss gatherings:

- Water supply
- Public health
- Sanitation
- Waste water management
- Solid waste management
- Noise pollution
- Air pollution

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1.1 Water Supply

Water is one of the most vital needs for survival. An adequate supply of water must be readily available at public places. The quality as well as quantity must be apposite enough for the intended purpose. The water should be portable and the properties of the available water must satisfy the prescribed norms of the region or the country. But the quantity of water supplied should depend upon various factors like: nature of event, crowd activities, strength of the crowd, event duration, location of the event, season or time of the year, environmental conditions, toilet facilities, food handling, washing and cleaning etc. These factors put pressure on water resources and affect the options and requirements of water management.

The water to be supplied for drinking and making food should satisfy the Drinking water Standards of the location where event is to be conducted. For example the drinking water standards in India are:

BIS CERTIFIED STANDARD AS PER IS 10500: 1991

S.No.	Parameter	Permissible Values
1.	pH	6.5-8.5
2.	Total Dissolved Solids	2000 mg/l
3.	Hardness	600 mg/l
4.	Alkalinity	600 mg/l
5.	Iron	1 mg/l
6.	Manganese	0.3 mg/l
7.	Chloride	1000mg/l
8.	Fluoride	1.5mg/l
9.	Arsenic	No relaxation
10.	Zinc	15mg/l

Table 1 Indian Standard for Drinking Water as per BIS specifications

1.2 Public health

Public health refers to all the organized measures (whether public or private) to prevent diseases promote, health and prolong life among the population as whole. Its activities aim to provide conditions in which people can be healthy and focus on entire populations not on individual patients or diseases.

The focus of health intervention is to provide health and quality of life through the prevention and treatment of diseases. Modern public health practices require multidisciplinary teams of public health workers and professionals. In selecting a site, especially an outdoor event, an analysis should be made of any potential hazards in the area. Hazards may include power lines, storms, waterways that may be prone to flooding or drought, bushfires, high winds, extremes of temperature, pests, large animals, pollens and poisonous plants.

Relevant health authorities must be consulted on safe and adequate water supply, food safety, sanitation requirements and waste management, water and swimming pool safety, pest/ vector control, infectious diseases prevention and investigation, building safety, noise and other nuisance issues, public health and emergency management.

1.3 Sanitation

The sanitation facility of Indian system is inadequate in every aspect though various measures have been taken to improve and provide better facilities. Lack in sanitation facilities lead to various types of diseases like diarrhea, skin disorder, etc. Government of India had launched a number of policies and programs in order to prevent open defecation but somehow the problem is still there intact. So it is a very important responsibility of organizing committee to account the sanitation facility as one of the important ones.

The nature and duration of the event is the major criteria of an event to ensure the adequate toilet facilities. These facilities should include water closet pans, urinals and hand basins. But the main subject is the facility should be adequate enough for the people attending the event. Also it should be conveniently located and suited for the event. The site should ensure easy access and minimum queuing. There must have the necessary provisions for collection, treatment, disposal of the wasted water. The process must be operated and maintained in a clean, tidy manner so that insanitary conditions never prevail. Toilet installation must consider: type, duration of event, crowd behavior and activities and food consumption.

Toilet design should consider having separate approach for each sex, disabled and senior citizens. The location should ensure privacy with proper hand washing basins, toilet papers, soap, bins to dispose nappies, sanitary napkins and the tissues etc.

To maintain facilities in a sanitary condition, toilets and washrooms should be cleaned at least daily or more frequently where necessary to prevent nuisance or offensive conditions and infestation by

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nuisance insects or pests. A cleaning schedule should be established for toilet facilities to cover frequency of cleaning, monitoring, equipment and chemicals to be used. A team of maintenance personal should be there in order to repair any blockages, to ensure refill the supplies of like soaps, buckets, mops, brooms, toilet paper etc.

1.4 Waste water management

Waste water is the major pollution that affects the surroundings as it augments the breeding conditions of flies, mosquitoes which thereby causes and transmits various diseases like malaria, dengue etc. The sewerage and draining system of any event shows the effective preparedness for the mass event. An event which lasts for a month or so should not only be ready with adequate system but also ensure the facility to remove it periodically. The waste water may include water from handwashing, food stalls, washing and cleaning, ablution blocks, and may be from crowd comfort facilities like spraying fans. The relevant health authority or agency must be contacted by the organizers to determine the requirements for all types of sewage and waste water disposal.

Generally for small scale events, a provision of small pits are ensured which collects the water for short period and later been disposed by the municipal corporation. But for a huge event, a proper sewage and the waste water collection inlets and pipelines should be laid which thereby take the waste to a treatment plant or the other sufficient treatment unit.

1.5 Solid waste management

Solid waste management (SWM) has three basic components: collection, transport and disposal. The objective of SWM is to reduce the quantity of solid waste disposed off in land or water bodies by recovering of materials and generate the energy form the collected solid waste in a cost effective and environment friendly way.

Under the Environmental Protection Act (EPA) 1986, MoEF has issued several notifications to tackle waste management which includes:

1. Municipal Wastes (Management and handling) Rules, 2000, whose aim was to enable municipalities to dispose off municipal solid waste in a scientific manner.
2. Hazardous Waste (Management and Handling) Rules, 1989, which brought out a guide for manufacture, storage and import of hazardous chemicals and for management of hazardous wastes.
3. Biomedical Wastes (Management and handling) Rules, 1998, were formulated along parallel lines for proper disposal, segregation, transport etc. of infectious wastes.

1.6 Noise Pollution:

Noise means unwanted sound that goes beyond the hearing capacity of human ear. In an event, noise pollution varies as audio speakers, loud speakers, public transport, firecrackers, chanting of priest in religious events, bells of temples etc. Noise pollution has severe effects: physically and psychologically. People continuously exposed to noise are often complains of hypertension, stress, hearing loss, sleeping disorder etc.

Central Pollution Board has defined Noise Pollution (Regulation and Control) rules, 2000 according to which air quality standards in respect to noise are:

S.No.	Area	Day Time (dB)	Night Time (dB)
1	Industrial	75	70
2	Commercial	65	55
3	Residential	55	45
4	Silence Zone	50	40

Table 2 Air Quality Standard by CPCB w.r.t. Noise

Note:

1. Day time means from 6:00 am to 10:00 pm
2. Night time means 10:00pm to 6:00 am
3. dB means decibel: unit in which noise is measured

For public events, especially outdoor, there is a strict need to apply guidelines for maximum noise levels that should be allowed at the boundary from the nearest private dwelling in the vicinity of the source of noise. Allow four to six weeks for an application to be processed (during that time the application is advertised in the newspapers, public notices etc for

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comments and objections). Information required for the application includes location, time, duration and sound equipment at the event.

It may need to consult an acoustic consultant on the impact of loud noise from the event on adjoining property and stock in rural areas. The relevant health authorities should be consulted if any local condition applies.

2. Air Pollution:

Air pollution has reached such a critical stage where it affects the earth's atmosphere as it lets in more harmful radiations from the sun. The major sources of pollution stem out of human activities like burning of fossil fuels, natural gas, coal, oil, factories and motor vehicles; all emit harmful substances. Among these harmful chemical compounds this burning adds to the atmosphere carbon dioxide, carbon monoxide, nitrogen oxides, sulphur oxides and particulate matters.

For Indian conditions, Central pollution Control Board has defined Ambient Air quality standards:

S.No.	Pollutant	Time Weighted average	Industrial, Rural and Residential Areas	Ecologically sensitive Areas
1.	Sulphur dioxide ($\mu g/m^3$)	Annual	50	20
		24hrs	80	80
2.	Nitrogen Dioxide ($\mu g/m^3$)	Annual	40	30
		24hrs	80	80
3.	PM_{10}($\mu g/m^3$)	Annual	60	60
		24hrs	100	100
4.	$PM_{2.5}$($\mu g/m^3$)	Annual	40	40
		24hrs	60	60
5.	Ozone($\mu g/m^3$)	8hrs	100	100
		1 hr	180	180
6.	Lead ($\mu g/m^3$)	Annual	0.5	0.5
		24 hr	1	1
7.	Ammonia ($\mu g/m^3$)	Annual	100	100
		24 hrs	400	400
8.	Carbon monoxide(mg/m^3)	8hrs	2	2
		1hr	4	4

A common problem at outdoor events is dust control. Large amount of dust may develop as a result of the crowd or vehicle movements. It create nuisance and can contaminate food and water arrangements. Dust also causes respiratory problems like allergies, asthmas and is more likely to affect the sensitive groups, children and senior citizens.

A consideration must be given in the planning stage to need for lawn or grass mowing, light watering and ground covering or on when it is carried out, how and by whom.

3. Sustainable Efforts

Mass events always require special management measures including non routine investments of public resources in order to manage and fulfill short term benefits, keeping in mind the sustainable utilization of the resources. But the condition of rapid fulfilling the demand like building a whole new arena for conducting an event with all the basic amenities causes imbalance. The challenge is to overcome the imbalance and properly manage the resources in best possible way.

This makes the role of technology very essential. Few technological methods that could be followed to make an event successful:

3.1 Hazard Identification and Risk Assessment

The first step for any mass event is to recognize any kind of hazard in the vicinity of the event area. The nature of hazard may vary according to location, but general natural hazards are always includes as earthquakes, floods, drought, fire breakdown, cyclones etc. Based on the nature of hazard, an adequate risk assessment should be carried out considering environmental, socio-political and economical factors like:

1. adequate ventilation, illumination,
2. no slip and leveled flooring,
3. safe access to equipments,

4. illuminated area layout to be put in display at regular noticeable places,
5. fire extinguishers, fire blankets and fire alarms provision
6. a regular check of the instruments and the facilities should be made with proper strictness
7. a team for emergency conditions should always be ready with their essential equipments.

3.2 Awareness

An emphasis should be paid on the public awareness. Various measures could be taken to ensure proper broadcasting of necessary information among people through media, electronic display, billboards, hoardings etc. Also pamphlets regarding DO's & DONT's should be widely distributed among the public. Each entry and exit gate's information should be clearly mentioned in an illuminated board at major junctions and routes. Police helpline numbers along with certain complaint numbers should also be mentioned in the pamphlets or the hoardings. To make a rumor free environment, a provision of loudspeakers should be present to make regular announcements in order to tackle the mishap or accident.

Apart from the above facilities, a special Help Desk should also be setup to entertain every kind of help, complaint, queries etc. with proper management which involves both men and ladies staff members.

3.3 Water Supply

Water is required for survival. It's the most important duty of an organizing committee to provide safe and portable drinking water. The water supplied should be uniform and the constant supply is enhanced by laying proper pipelines carrying drinking water from Water Board Supplies. The pressure should be sufficient enough to meet the required demands at all outlet points. Water should be readily accessible at all food premises, ablutions, toilets, laundry, designated standpipes, fire fighting, first aid posts and all the other required area. But it is strongly be available by the recognized water authority supply.

If event is arranged in a smaller scale, tanker facilities could be provided. But for the large scale events lasting from few days to months, spigots could be installed along with the water purification facility.

The quality of water for drinking and washing should be different as to retain the good quality water resources so that it cannot be wasted for washing and cleaning purposes. But the non potable supplies are to be clearly identified as non drinking purposes. The recycled water should be used for cleaning, gardening, washing, flushing etc. The recycled water can also be used for fire fighting, dust suppression and even sometimes for luxuries activities like spraying fans, coolers etc.

3.4 Health & Sanitation

Public health is the most significant area of concern. There are numerous ways to create a clean environment for the mass event like regular fogging for pest control, cleaning of stagnant water pits to control the breeding of mosquitoes and flies, hospitals and health centres should be setup with qualifies doctors and nurses to take proper care of the patients, the medicines and other important equipments for the treatments should be present, an ambulance facility should be provided in case of emergency.

There are various methods by which the sanitation of the mass gathering event can be progressed. By technological advancements, different kind of toilets have been developed which can temporarily provides effective and clean sanitation facility:

3.4.1 Ecological Sanitation

These are also known as eco-san, it is a form of sanitation that usually involves urine diversion and the recycling of water and nutrients contained within human wastes back into local environment. Ecosan is based on an overall economical, environmental, sustainable wastewater management system which has been developed to fulfill the need of users as well the local conditions. It provides a flexible framework where the centralized elements can be combined with the decentralized ones, waterborne with dry sanitation high-tech and low-tech etc. by considering a much larger range of options, optimal and economic solutions can be developed for particular situation.

The basic advantages of ecosan are:

1. Improvement of health by minimizing the introduction of pathogens from human excreta into the water cycle.

2. Promotion of safe, hygienic recovery and use of nutrients, organics, trace elements, water and energy.
3. Preservation of soil fertility
4. Contribution to conservation of resources through lower water consumption, substitution of mineral fertilizers and minimization of water pollution
5. Improvement of agricultural productivity and food security
6. Preference for modular, decentralized partial flow-systems for more appropriate cost-efficient solutions adapted to the local situations
7. Promotion of holistic, interdisciplinary approach
8. Material flow cycle instead of disposal of valuable resources

3.4.2 Portable toilets

These are simple portable enclosures containing a chemical disinfectant instead of water. It is a temporary toilet used for large gatherings with minimal uses of water. Most portable toilets have black open front U-shaped toilet seats with a cover. They are often constructed out of light weight molded plastics.

Advantages: Portable toilets have several significant benefits mostly related to their portability; it can be drained, cleaned, disinfected and deodorized on a regular basis. It's cheaper as they are not plumbed, they don't clog. An average portable toilet is able to hold enough sewage for 10 people during the course of a 40 hour work week before the hold reaches unsanitary conditions.

Disadvantages: Since they are not plumbed, they keep waste inside the bathroom; this leads to smelly conditions, if not cleaned properly and periodically. This is also considered as an eyesore in most communities, some of which prohibit its use without permission of municipalities.

3.4.3 Bio- digester Toilets

These are based on anaerobic biodegradation of organic wastes by unique microbial consortium was conceived and developed by DRDO for defense forces deployed at higher altitudes areas. In this system, fecal matter is decomposed in bits and converted into water and little carbon dioxide & methane gas. It is totally maintenance free system and doesn't require any sewerage system.

Working: A consortium of anaerobic bacteria has been formulated and adopted to work at temperature as low as 5 degree C. this is the component t which acts as inoculums to the bio digesters and converts organic matter to methane and carbon dioxide. The anaerobic processes in-activates the pathogens responsible for water borne diseases. Bio digester serves as reaction vessel for bio methanation and provides the anaerobic conditions & required temperature. The optimum temperature is maintained by microbial heat, insulation of reactor and solar heating.

Biological Process in Digesters:

Fecal matter is composed of carbohydrates, fats and proteins. A four step mechanism of decomposition is:

1. Hydrolysis: simple sugars, amino acids and fatty acids are break down into simpler compounds
2. Acidogenesis: formation of carbonic acid, alcohols, hydrogen and water
3. Acetogenesis: acetic acid, hydrogen and carbon dioxide is formed
4. Methanogenesis: conversion of all compounds to methane and carbon dioxide and neutral water (pH: 6-9)

The final product is left with no solids, only gases and water.

Disadvantages:

Expert and skilled persons are required for design, construction, operation & maintenance depending upon the scale. Reuse of produced energy needs to be established. Sulphurous compounds leads to odour.

3.4.4 Pit Toilets

It is a dry system which collects human excrement in a large container or a pit or a simple slit trench with ventilation facility. They are basically used in rural areas or wilderness which lacks all the basic requirements. The waste pits in some cases may be large enough that the reduction in mass of the

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contained waste products by ongoing process of decomposition allows the pit to be more or less permanent. In other cases, when pit becomes too full, it may be emptied or hole may be covered by soil and rebuilt over a new pit.

The anaerobic decomposition takes place along with emissions of the gases and volume of sludge is reduced. There will also be die off bacteria and viruses during storage and as the water percolate through the soil so the pollution of groundwater occurs. Control of odour and insects can be achieved by a vented pit.

The period of emptying depends on the size of pit and its usage. it is desirable to store at least one year of sludge production.

3.4.5 Dehydrating Toilets

It is traditional indoor toilet in which urine is diverted to a collection tank or a soak pit under the toilet vault or outside the toilet and feces drop into one of the two vaults, below the toilet seat. When one vault is full, it is then sealed and another one is used. Materials like ash or soil or a mixture of sawdust/lime or soil/lime are added for defecation. The dry material assists the desiccation process and raises pH which aids in pathogen reduction.

3.4.6 Composting Toilet

It is a dry toilet that uses predominantly aerobic processing system that treats excreta with no water or low flush water via composting or managed aerobic decomposition. It can be used as an alternative to flush toilets in water scarce locations or where there is no provision of waste water treatment facility available or to capture the nutrients in human excreta. The decomposition of human sludge takes place in presence of air i.e. aerobic decomposition in an elevated latrine. They are used in many of the roadside facilities and public toilets.

Air can be introduced through an operating to pass through sludge and exit through the vent. Excess liquid is allowed to drain for collection or evaporation. The human excrement is normally mixed with sawdust, coconut coir or peat moss to support aerobic processing, absorb liquids and to reduce odor. The decomposition process is generally faster than anaerobic decomposition used in wet sewage treatment supply like septic tank.

3.5 Solid Waste Management

There are various measures by which solid waste can be collected or recycled or reused:

1. Collection of waste generated at source will not only reduce the burden on the Municipal Corporation but also it saves time and the cost employed on segregation. The authorities should install adequate collection bins at major routes and location and these bins should be emptied at frequent intervals to maintain a clean and hygienic environment.

2. Availability of adequate number of sweepers and waste disposal units should cover the entire event area. Containers or garbage bins should be placed in large open areas as approximately 4 per acres.

3. Reduce, reuse and recycle should be the main motto of any event to take place by preventing harmful biodegradable materials such as plastics, polythene from entering nearby water body and providing alternative options for processing.

4. Exploring creative and innovative ways in which solid waste can be used as a source of fuel in form of by products like biogas. Also an alternative option of eco packaging could be employed.

5. Waste disposal or landfill sites should be identified well in advance if required in case of urgency. The efficient facility to transport the waste from event site to dhalao and from dhalao to landfill or waste processing site should be ensured.

6. A maintenance schedule should be set up to monitoring the work efficiency of the sweepers and required workers.

7. The placement of containers and all the treatment units depends upon the size of event and the crowd gathered. In high traffic areas such as spectator stands, seating toilets,

handwashing area, activity areas along walkways from food booth etc. the frequent and easy removal facility should be present for proper management.

3.6 Fire Services

Fire extinguishers should be installed at all places where there are maximum chances of frequent gatherings. Fire brigade should reach on time merely by fire alarms. In case of emergencies, a team should be dedicated to take control of the situation. The recycled water should be used for fire breakdown. The pantry, kitchens with LPG etc should be taken into special consideration. The combustible materials should be limited from the event area. The security personnel can ensure such strictness. The fire crackers, bits of cigarettes, smoking choolahs, hookas etc should be limited as far as possible.

3.7 Air Pollution Control

Air borne pollution is the important issue to be taken into consideration. The transfer or movement of crowd, vehicles etc leads to generation of dust. Even in high wind areas, there is dust all around. Fugitive dust particles adversely affect the workforce health and can interfere with the food and water quality.

Concern regarding smoking is also increasing day by day. It kills not only the smokers but it enhances the passive smoking effects. Smoking affects major body parts like heart, lungs, skin, bones, stomach, mouth, throat, reproduction and fertility as well. Public health can be accounted by implementing smoke free policies in major gathering areas. Benefits would include decreased cleaning costs, better public image, the reduction of second hand smoke drifting onto major public areas and reduce nuisance impact for general public as well.

Dust suppression could be possible as:

1. Applying gravel to a dirt road surface.
2. Sealing unpaved roads with pavement or impermeable materials.
3. Reducing exposed ground by maintaining vegetation.

3.8 Waste Water Control

All the liquid been generated from washing, cleaning or cooking activities should be disposed off efficiently in an approved manner. For a small scale function, a provision of pit can be used but for a large scale even proper treatment units should be employed. The organizers should have sewage pump out truck available on site at all time or on standby status for servicing the portable or other toilets.

In order to control insanitary conditions, sewage and waste water collection, treatment and disposal systems must be constructed and operated to prevent contamination of food or water supply. For insufficient sewerage system, the relevant health authorities should be contacted to determine the requirements for all type of sewage and waste disposal.

3.9 Noise Pollution Control

For public events especially outdoors there is a need to apply guidelines for the maximum noise level typically allowed at the boundary from the nearest private dwelling in the vicinity of the source of noise pollution. Allow 4-6 weeks time for an application to be processed so that there is time left for comments and objections by affected public and the relevant stockholders in the area. Information regarding time, location, duration of the event along with the sound equipment functionality should be provided by the organizing committee to the relevant authorities.

It may need to consult an acoustic consultant on the impact of loud noise from the event adjoining property and stock in rural area.

3.10 Mass Casualty Management

Mass causalities are characterized by the severity, diversity of injuries, availability of aid, time, etc. An effective mass management plan requires an establishment of baseline that is an assessment of current system's capacity against which planned changes can eventually managed. A second key initiative should be taken to provide detailed understanding of hazards and risks. Emphasis should be paid on gathering retrospective data of previous similar events. This should not be limited to large scale disasters but also to the smaller ones like major traffic congestions, industrial incidents, chaos, building collapses and so on. It should not include a forward looking component assessing risk in future from the elements such as unsafe urban development or change in weather patterns.

This also necessitates the development of training modules and guidelines, monitoring and

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surveillance and early warning, stockpiling, collaboration with NGO's and corporate sectors as partners and thus finally developing a culture of community preparedness. It requires the paradigm change from the application of unlimited resources for the greatest good of each individual patient to the allocation of limited resources for the greatest good of the greatest number of causalities.

4 Conclusion

Mass gatherings are preplanned public events held at specified location for a definite interval of time that strains planning and response resources. The goal of public health management at mass event is to prevent or minimize the risk of injury, ill health and to maximize the safety for participants, spectators, event staff and residents in the vicinity. This can be achieved through risk assessment, planning, surveillance and response.

The backbone of any response plan is the ability to communicate. For mass event, there is an need to establish a effective communication system that us both interoperable and redundant. There is a need to develop a plan for communicating with the public in the event of a health crisis. Coordination and effective communication can cut off the issues. The use of advanced sustainable technology has made the way a far better which enables a rapid and coordinated system of effective management. Considering the nature of mass event, special planning is to be provided for emergency or ongoing medical care is necessary to effectively deliver a stress free services.

A mass gathering often brings together organization that has never worked together. It is very important to establish excellent coordination systems, supported with inter agency agreements, to ensure all organizations involved should involve understanding their respective goals and responsibilities. It is always a need to establish a command and control function to manage situations as they arise.

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