

## EMERGENCY MEDICAL AND HEALTH CARE AFTER EARTHQUAKE DISASTER

P. DHARMARAJU\*

### INTRODUCTION

In India, the main seismic zone runs along the Himalayan mountain range and in the Rann of Kutch. Very strong earthquakes originated in this belt in the past and caused great devastation resulting in large number of deaths and injuries and extensive loss of property. The large number of casualties was due to the collapse of poorly constructed and heavily occupied buildings.

There is no seismic hazard without people. Earlier, the foot hills of Himalayas were relatively thinly populated. But due to growth of population by many folds and consequent increase in density, and indiscriminate land use over years, existence of old and new constructions especially the residential dwellings which are not earthquake-resistant, tend to augment the vulnerability of the population to earthquake disaster in terms of mortality, injuries and health hazards. Risk acceptability on the part of the vulnerable population and tendency of earthquake experience receding in memory as the time passes have contributed to increased destructive capability of the earthquakes.

### EFFECTS OF EARTHQUAKES ON THE POPULATION

Earthquakes of severe magnitude cause extensive loss of human lives leading to death of earning members; some of the children become orphans. Apart from deaths, earthquakes cause major injuries such as head injuries, crush injuries, limb injuries, rib cage compression and spinal injuries due to collapse of building walls and roofs. Burns of varying degrees are caused due to fire. The number of people who may be killed or injured by an earthquake varies with several factors including (a) location of shock with respect to population centres (b) the types of building construction occupied by or adjacent to people (c) the time of the day (d) accompaniment of fires (e) promptness and efficiency of search and rescue operations and (f) quality of emergency medical care.

\*Consultant in Disaster Medicine.

Convener Helms Sub Committee (Indian Standards Institution) F-6/A, Hauz Khas Enclave, New Delhi-110016.

Socio-economically, population rendered homeless are required to be evacuated and sheltered in the evacuee camps. Immediate large scale unemployment results on account of complete dislocation of normal life. There may be outbreaks of looting in the impact zone.

The normal environment of the affected population is altered adversely by the earthquake disaster which brings about almost hostile environment with attendant health hazards which tend to assume enormous proportions by way of out-break of epidemics unless adequate and effective measures are undertaken in time to prevent the emergence and spread of the disaster associated diseases. Contamination of drinking water wells and urban piped water supply system takes place after earthquakes. Consequently, the incidence of gastro-intestinal diseases such as infective diarrhoea, dysenteries, gastro-enteritis and infectious hepatitis (Jaundice) tend to increase in great proportion. The other potent factors are overcrowding and poor sanitary conditions of the evacuee camps giving rise to health problems by way of incidence of eye and skin infectious and infectious diseases like measles, chicken pox, etc. The morbidity rate in respiratory infections tends to rise in infants and children. Dog bites also increase following some earthquakes.

The emergency medical and health care to the earthquake stricken population can be effectively delivered by community disaster preparedness and contingency anti-disaster planning at all administrative levels of the Government of the earthquake-prone States and also by voluntary relief organisations, researching periodically and updating the plan and finally executing the plan in its various aspects for mitigating the human suffering and distress when the earthquake strikes.

### COMMUNITY DISASTER PREPAREDNESS

It is desirable that the community in the earthquake-prone States is prepared adequately to face the disaster in a regulated and organised manner by educating the people about the hazard and make them conscious of it. The community should be orientated regarding danger to life, injuries and various health hazards which are likely to occur as a result of earthquakes by utilising the mass media. Voluntary organisations could play an important and useful role in the field of community disaster preparedness by establishing an effective rapport with the community groups at the grass root level. Education to school children in this regard could be imparted through their curriculum.

The vulnerable community should be made conversant adequately with the earthquake safety rules. These precautions taken before, during and immediately after the earthquake may make a difference

between survival and death for the members of the community. There are no specific rules and formulae which can eliminate all hazards but they can be greatly reduced by following the simple rules outlined below:

### **BEFORE THE EARTHQUAKE**

- (a) Check your own home for earthquake hazard and some useful hints are as follow:
  - (i) Ensure that water heaters and gas appliances are firmly fixed and shut off when not in use as broken gas pipes or appliances are likely to cause fire damage. Use flexible connections wherever possible.
  - (ii) Securely fasten fixtures and shelves to the walls and place large and heavy objects on the lower shelf. Top heavy objects should be braced or anchored.
  - (iii) Responsible members of the family should be taught how to turn off electricity, gas and water at the main switches and valves.
  - (iv) All lofts and attics should be kept free from all inflammable materials.
  - (v) Whenever possible, the existing houses which are not of earthquake resistive construction, should be retro-modified for earthquake resistance. Likewise, the hospitals, schools and other public buildings which serve the community should also be retro-modified for resistance against seismic activity.
- (b) Responsible and able-bodied family members should receive the training in simple methods of rescue, fire-fighting and basic principles of first-aid.
- (c) Keep stocks of drinking water, some food-stuffs, first-aid equipment, a crow bar, shovel, pick, rope, flash light (electric torch), some candles, and a battery powered transistor radio ready for use at all times.
- (d) Ensure that the immunisation state in respect of all the members of the family is up-to-date in respect of water-borne diseases and tetanus.
- (e) Education of the public on health hazards and community behaviour should be imparted on the following:—

- (i) The importance and necessity of safe and potable drinking water in order to prevent the incidence of waterborne diseases due to contamination of drinking water in urban and rural areas and simple and practical methods of purifying water.
  - (ii) Community living in the evacuee camps—personal involvement in the correct use of temporary sanitary installations and maintaining optimum environmental sanitation.
- (f) Village/Community Volunteer Force may be raised utilising energetic and enthusiastic youngmen and women willing to do community service in an event of emergency. They could be drafted from among Yuvak Mandals, Village counterpart of home guards or any other voluntary organisations. The Voluntary Force should be properly trained and adequately equipped for undertaking following tasks at short notice.
- (i) Carrying out initial survey of the disaster affected zones including remote and isolated areas immediately after the impact and report to the appropriate Government authorities.
  - (ii) Participating in search and rescue, rendering life-supporting first-aid to the injured and evacuating the casualties to the nearest hospital.
  - (iii) Helping in orderly evacuation of the population rendered homeless taking special care of weaker segment of the population namely infants, children, expectant mothers, the old and the infirm.
  - (iv) Participating in cleaning up the streets, removing the debris from fallen buildings and clearing the roads to allow the rescue patrols to come in.
  - (v) Undertaking primary relief operations like distribution of food, clothing, water purification tablets, etc. to the disaster victims.
  - (vi) Helping in the disposal of the dead.
  - (vii) Participating in erection of emergency shelters with essential sanitary facilities for the evacuees whenever and wherever necessary and providing security to houses recently destroyed.

- (viii) Actively involving in positive health care measures such as supply of safe and potable drinking water, environmental sanitation, education of disaster victims in sanitation, epidemiological surveillance, anti-fly measures, mass immunisation programmes, etc.
- (ix) Tracing the missing individuals.
- (x) Taking care of the children rendered parentless by entrusting them to orphanages.
- (g) Hold occasional house earthquake drills so that the families have the knowledge to avoid injuries and panic in the event of an earthquake. Conduct family discussions about earthquake and fire hazards. Likewise, occasional rehearsals should be conducted by the Voluntary Force with a view to refreshing their skills and updating the procedures.
- (h) The vulnerable population may be educated on cheap and earthquake resistant housing construction practices using locally available building materials after proper siting based on appropriate land use planning.
- (i) In the wake of expanding medical care facilities and educational institutions, proper location, design and construction of hospitals, schools and colleges, etc. should be undertaken to withstand future earthquake shaking and ground failure. The relevant building code formulated by the Indian Standards Institution should be followed in this regard.
- (j) Be sensitive about what to do in various situation so that you are prepared in the event of an earthquake. Such awareness may enable you to act calmly and constructively in an emergency.

## 2. DURING THE EARTHQUAKE

- (a) Remain calm, think thorough the consequence of any action you plan to take, try to calm and reassure others.
- (b) In the event, the safest place is an open space away from buildings. However, when this is not possible, do not try to run from a building during an earthquake.
- (c) If it catches you indoors, do not run outside and stay indoors. Take cover under a desk, table, bed bench or in doorways and against inside walls. Stay away from glass windows. Do not

stay inside buildings with a large roof span unsupported by walls.

- (d) Do not use candles, matches or other open flames either during or immediately after the earthquake. Put out all fires.
- (e) If the earthquake catches you outdoors, move away from buildings, public utility wires and other objects that could fall. Once in the open, stay there until the tremors stop.
- (f) Do not run through or near buildings. The greatest danger from falling debris is just outside doorways and close to outer walls. If possible move to an open area away from hazards.
- (g) If you are in a moving automobile, stop as quickly as safety permits, preferably in an open area but stay in the vehicle until the earthquake stops.

### 3. AFTER AN EARTHQUAKE

- (a) Check for injuries in your family and neighbourhood; you should not attempt to move seriously injured persons unless they are in immediate danger of further injury of fire
- (b) Check immediately for fires or fire hazard.
- (c) Use foot wear in all areas near debris and broken glass.
- (d) Check utility lines and appliances for damage. If gas leaks exist, shut off main gas valve. All electrical power should be turned off.
- (e) Do not use matches, lighters or open flame appliances (such as hurricane lanterns, etc.) until you are sure no gas leak exists. Electrical switches or appliances should not be operated if gas leaks are suspected. This creates sparks which can ignite gas from broken lines.
- (f) No one should touch downed power lines or objects touched by the downed lines.
- (g) Check and see that sewage lines are intact before using/flushing of toilets.
- (h) If drinking water supply is off, emergency water may be obtained from water heaters, toilet cisterns, melted ice cubes, etc. Draw moderate quantity of water in case service is disrupted.

Do not draw large quantity as this could interfere in the fire fighting.

- (i) Do not eat or drink anything from open containers near shattered glass. Liquids should be strained before consumption.
- (j) Spilled medicines, drugs and any other potentially harmful materials must be immediately cleaned up.
- (k) Transister Radio must constantly be turned on for damage reports and informations.
- (l) Closets and storage shelf areas should be checked. Closet and cupboard doors should be opened carefully and objects falling from the shelves should be watched.
- (m) Rumours should not be spread as they often do great harm.
- (n) No one should go sight-seeing immediately.
- (o) Community should help in keeping streets clear for passage of emergency vehicles.
- (p) Stay out of severely damaged buildings, after-shocks can crash them down. Although most of the after-shocks will be smaller than the main shock, some may be larger or at least enough to cause further damage to already weakened structures. There is need for the people to be in the open.
- (q) Every one should respond to requests for help from police, fire-fighters, Civil Defence Personnel, Home Guards and Voluntary Relief Organisations but not go into the damaged areas unless help has been requested. Complete cooperation must be given to public safety officials.
- (r) Village Volunteer Force should be deployed for undertaking post-disaster duties as outlined earlier.

As regards health hazards, the community should be made aware on the necessity of water-borne diseases due to contamination of drinking water in urban and rural areas following earthquake and should also be educated on simple and practical methods, of purifying water. Education on positive health measures such as community living in the evacuee camps, personal involvement in the correct use of temporary sanitary installations and in maintaining optimum environmental sanitation, should be imparted to the vulnerable population. Community preparedness and advance knowledge on life and health hazards would

evoke disciplined and regulated response and would bring about positive attitude which would contribute in allaying adverse psychological effects among the population exposed to the calamity. It may be mentioned that the results of mass education on these matters of disaster preparedness will not be dramatic but it is anticipated that continuous and sustained effort would yield fruitful results.

### CONTINGENCY ANTI-DISASTER PLANNING

Contingency anti-disaster plan should be drawn up by the vulnerable State Government and also by the Voluntary Relief Organisation for the disaster management from the time of the initial impact, through the rescue and relief phases to the final period of reconstruction and rehabilitation. Effective planning and continuous preparedness to provide quick and efficient rescue and relief together with adoption of such preventive measures would help in saving more lives, lessening human suffering and reducing residual disability.

In every earthquake-prone State, the history of the past earthquakes should be catalogued and studied as to the frequency and the effects. From these, the known earthquake hazards can be identified and areas likely to be affected can be defined as it is common for earthquakes to occur repeatedly along the same fault over a long period of years. The factual information from such analysis should serve as basis for development of earthquake mitigation plan.

While undertaking the contingency planning for the emergency medical and health care, the following factors may be taken into consideration.

### TASK FORCES FOR SEARCH AND RESCUE

Immediately after the impact of an earthquake, the first and the foremost task is to search for and rescue people who are trapped, injured, old, disabled or for any other reason unable to escape from dangerous zones. Fire control, removal of the debris to make way, extrication of the buried but yet alive persons, recovery of the human dead from the debris, etc., are tasks connected with the search and rescue. A set of trapped persons locating apparatus consisting of acoustic capsons and biophone has been found useful for locating live persons under the debris.

Search and Rescue operations are highly skilled and specialised tasks which should be undertaken in an organised manner by specially trained and qualified persons utilising special, specific and sometimes improvised equipment for the purpose as the situation demands. These



operations should be conducted promptly and energetically by teams consisting of able-bodied persons in order to save more lives and limbs, mitigate human suffering and minimise residual incapacity. However, while searching and rescuing, every precaution must be taken to avoid worsening the condition of the injured and endangering safety of the rescuer. Use of transreceiver sets by the members of the rescue team is highly desirable while conducting search and rescue operations.

At present, none of the disaster-prone States are properly geared with search and rescue organisations with properly equipped and trained persons for the purpose and it is therefore, highly desirable that Task Forces should be created and organised by the individual vulnerable States utilising the existing manpower resources of Civil

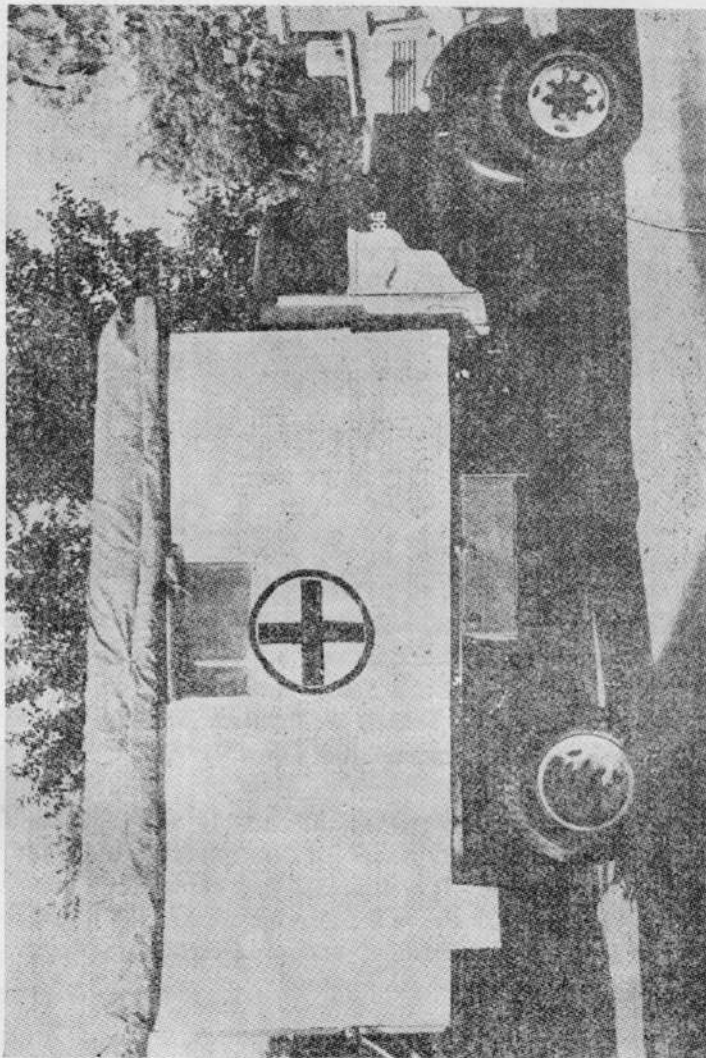


Fig. 1. A 3 ton vehicle modified into mobile operation theatre complex with pre and post operative rooms in lean-to-tents rolled up.

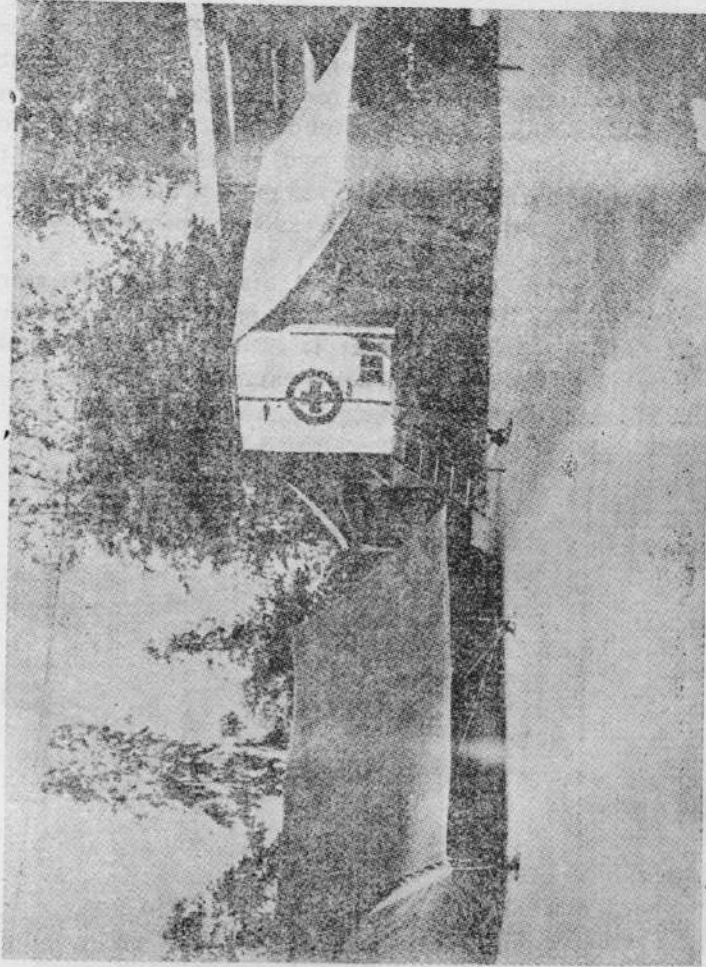


Fig. 2. Mobile Operation Theatre Complex fully deployed showing sterilisation tent on the left, and rear of Operation Theatre vehicle with pre and post operative rooms in the right and left lean to tent respectively.

Defence, Home Guards, Fire Brigade, Police, etc. Such Task Forces should also be built into the organisation of the Voluntary Relief Agencies like the Indian Red Cross Society. Generally, the Task Forces are comprised of elements of rescue, fire-fighting, first-aid, communications, and administration (Command and Control).

The Task Forces properly trained and suitably equipped should be positioned at pre-selected nodal places for deployment at short notice in the event of an earthquake. It is desirable that experienced and senior representatives of the Task Force are also included in the initial reconnaissance team for damage assessment and to ascertain the areas and quantum of deployment of the Task Force(s).

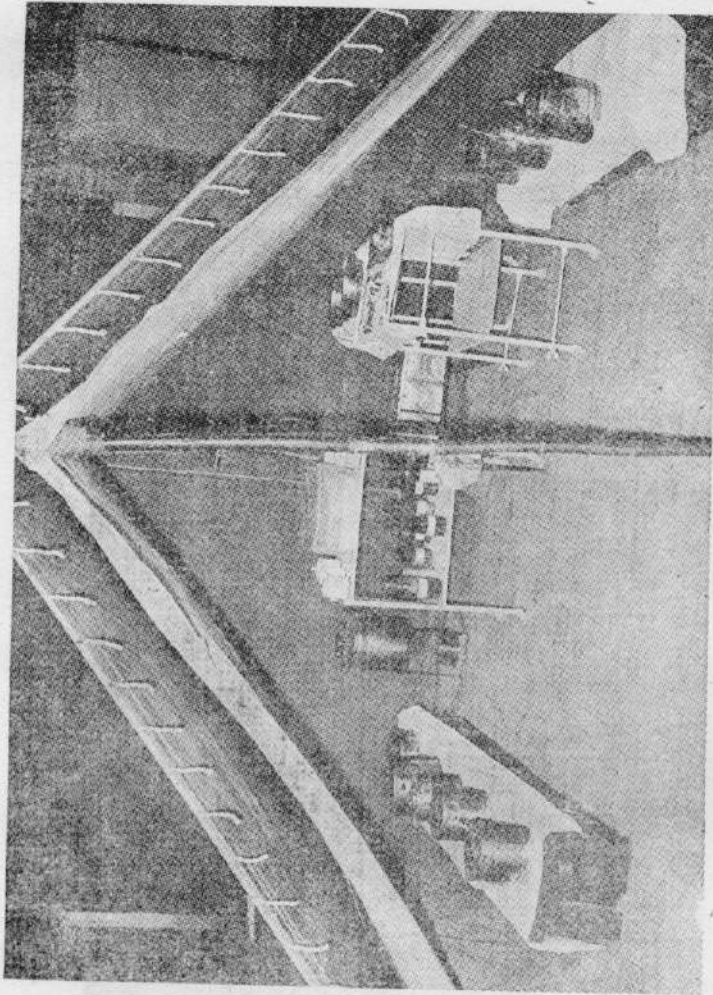


Fig. 3. Sterilisation Tent showing portable high pressure steam steriliser with four burner stove foldable trolley for antiseptic lotions, blades, needles and scissors, two basin trolley for used instruments, Trolley for sterilised instruments, drums of different sizes containing sterilised dressings.

### BODY RECOVERY DOG TEAMS IN SEARCH AND RESCUE OPERATIONS

Dog Teams should be trained to detect and locate the human casualties in the earthquakes, land slides and avalanche disaster wherein search and recovery operations are hampered by organic and building debris and rocky boulders. The Dog Teams should be deployed along with the Task Forces engaged in search and rescue operations.

### MEDICAL AND PARA-MEDICAL MANPOWER

Additional medical and para-medical personnel are required to be mobilised for manning first-aid teams and first-aid posts, temporary

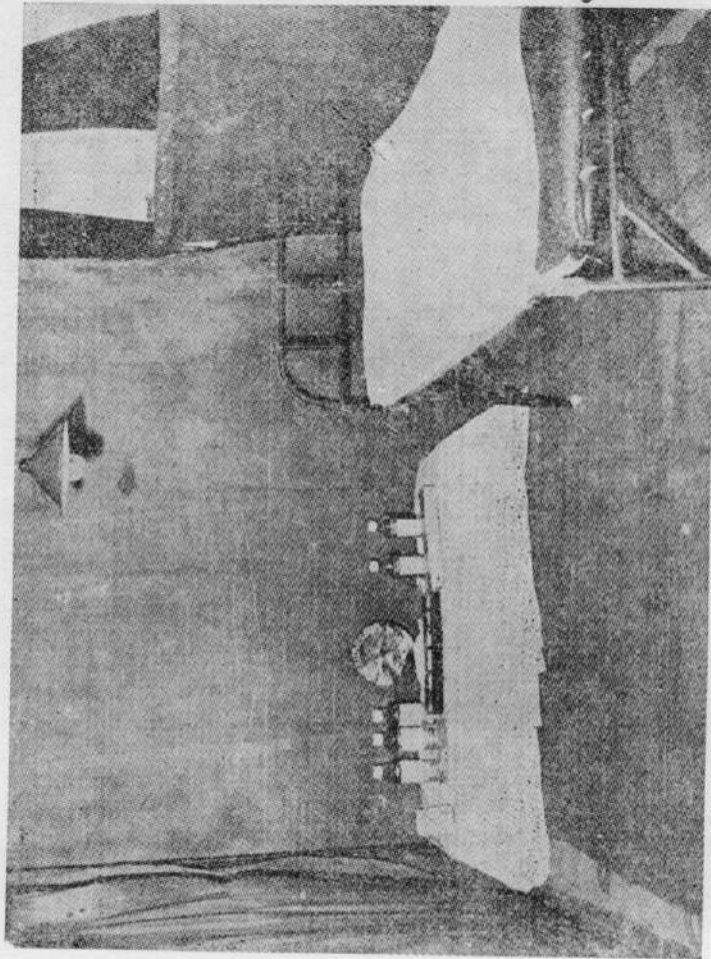


Fig. 4. Pre-operative Room-showing folding bed stead, I.V. fluids and infusion sets.

dispensaries, mobile medical and surgical teams and field hospitals to be deployed in the earthquake and landslide disasters stricken areas. This additional manpower may be drawn from major hospitals, medical colleges and other medical institutions in the non-vulnerable and non-affected areas of the State/Union Territory. In fact, the major hospitals and medical colleges in the earthquake-prone States should be the main sources for mobile medical and surgical teams which should fan out into the affected areas immediately after the disaster strikes. Home Guards and Civil Defence personnel may also be utilised for similar purposes. The personnel of various categories should be earmarked for the specific purposes by name in advance. It is also important to have reserve of personnel as the disaster can hit the personnel themselves, their aid posts, equipment and medicaments, etc.

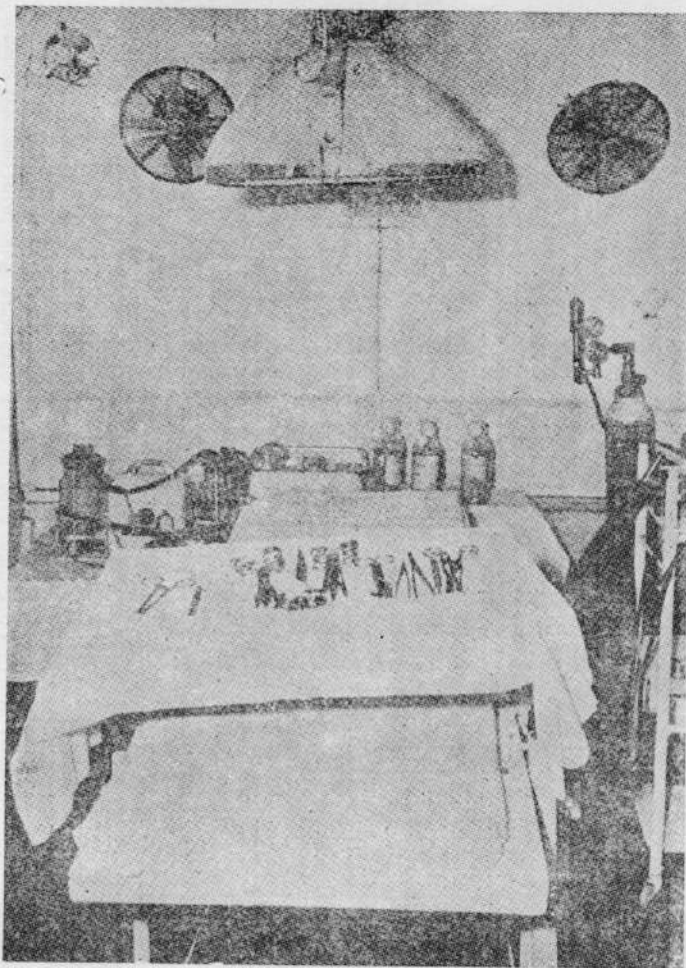


Fig. 5. Interior View of Operation Theatre (front section)-showing operation table with instruments tray, Anaesthetic Trolley with EMO Apparatus, Oxygen Cylinder complete with accessories, Anaesthetic Drugs and I.V. Fluids, Suction Apparatus, Adjustable Shadowless Light, Electric Cabin Fans, and Exhaust fan.

### MOBILE SURGICAL UNITS

Severe injuries are caused by earthquakes and landslides due to collapse of walls and roofs and rolling boulders and consequent burial under debris, violent impact against stationary objects and falling trees, electric and telephone poles, etc. Mobile Surgical Teams are required to be deployed for extrication of casualties who are trapped and submerged under debris and for institution of prompt treatment for pain,

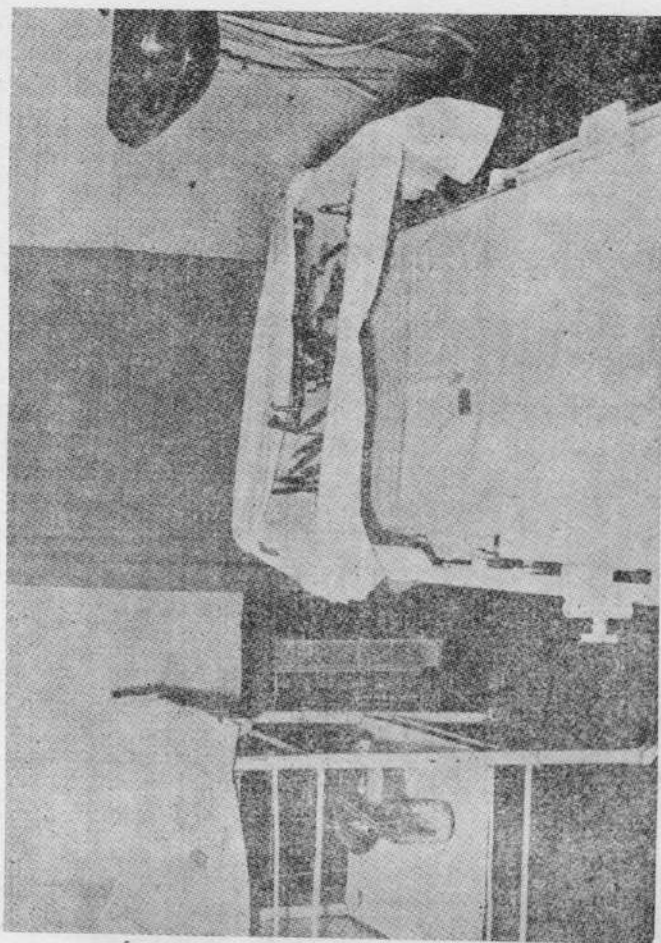


Fig. 6. Interior View of Operation Theatre (Rear Section) showing trolley with Surgeons' gowns, gloves, caps and masks, Air Cooler, stainless steel wash basin with foot operated bib-cock and operation table with the instruments tray in the centre.

shock arresting haemorrhage, adequate resuscitation and immediate surgery on the spot would save many a life and limb. For this purpose, the earthquake-prone States should be geared with Mobile Operation Theatre Complexes—operation theatres on wheels which are self-contained in all respects, viz., sterilisation, pre and post operation departments (Fig. 1-7). The Mobile Operation Theatres should be kept in a state of readiness in pre-selected hospitals with pre-sterilised packs for quick deployment of Mobile Surgical Teams at short notice. The staff should be earmarked and moved along with the Mobile Operation Theatre. The Mobile Surgical Teams should be deployed along with the rescue teams/Task Forces for their effective utilisation.

#### MOBILE FIELD HOSPITALS

One or two self contained 50-100 bedded Mobile Field Hospitals

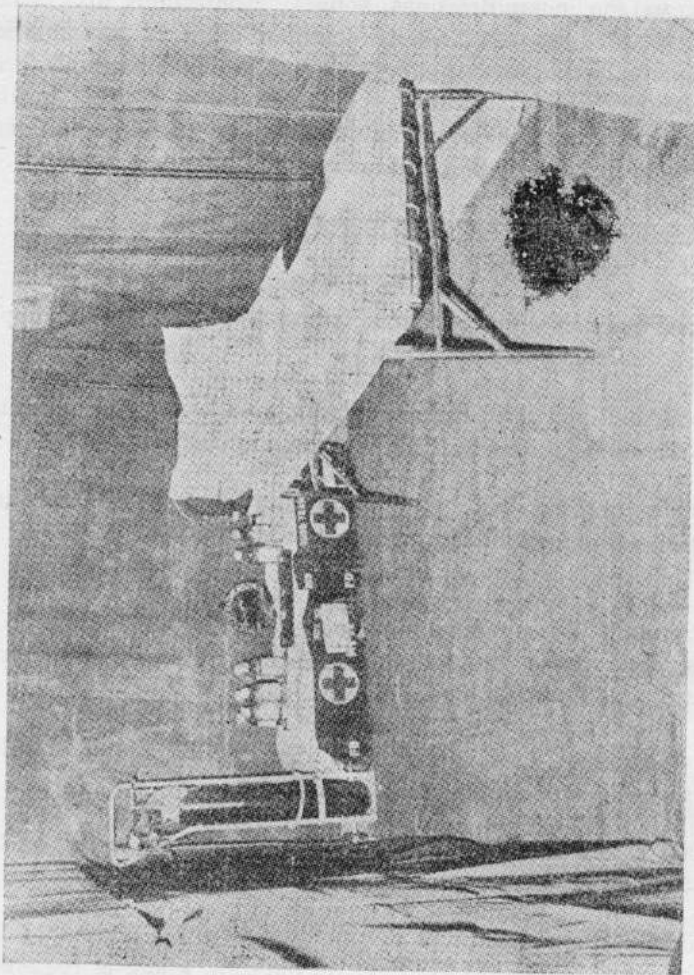


Fig. 7. Post-operative Room-showing folding bed stead. Trolley mounted oxygen cyl. I.V. Fluids & Infusion Sets.

are required to be raised by the earthquake-prone States for quick deployment at short notice. These hospitals may be set up whenever Mobile Surgical Teams are deployed for immediate hospitalisation of the cases after emergency life and limb saving surgery. Such hospitals may also be deployed for housing in-patients of large number of cases of acute gastro-enteritis and also for isolating cases of infectious diseases if occurred in the evacuee camps. The necessity of Field Hospitals also arises when the existing hospitals are severely damaged by the earthquake and thus become unserviceable. The Mobile Field Hospitals should be capable of being deployed in smaller sections of 20-25 beds. They are normally tented and the equipment is foldable and portable. It is advantageous to deploy them in built-up accommodations such as school/college buildings, etc.

### STOCK-PILING OF ESSENTIAL MEDICINES, ETC

All essential medicines, dressings, splints, disinfectants insecticides and vaccines required for treatment of common ailments and injuries and mass immunisation should be stockpiled in nodal hospitals from where they can be rushed to the affected areas at short notice. In the earthquake-prone areas the hospitals should gear up with additional portable folding operation tables and instruments.

### STOCK-PILING OF WATER PURIFICATION CHEMICALS, EQUIPMENT

Sufficient quantity of the following may be stock-piled for supply of safe and potable drinking water:

1. Bleaching powder (containing 25% available chlorine) water purification tablets (Chlorine/halazone tablets).
2. Plastic containers with air-tight lids and screw caps for retailing the bleaching powder for use by the Mobile Health Teams in the field.
3. Horrock's Boxes and Chloroscopes (Orthotolidine Test Kits) for determining the dosage of bleaching powder and for instituting quality control respectively.
4. Jerrycans for transporting and distributing potable drinking water.
5. 6000 Litres canvas tanks for purification of water on the banks of a river, stream or canal.
6. Potable water purification plants for purification of small quantities of water (150 litres) 'on the spot' wherever required.

### STOCK-PILING OF STRETCHERS AND BLANKETS

Sufficient number of stretchers and blankets for undertaking mass evacuation of casualties should be stock-piled at vulnerable and nodal hospitals and primary health centres from where they can be rushed to the affected areas. In addition, these stretchers and blankets can be utilised for converting general service vehicles (trucks and lorries) into patient-carrying vehicles and also as stretcher beds. Few hard board stretchers, Niel-Robertson stretchers should also be stock-piled; the former would be very effective for evacuating suspected or frank cases of spinal injuries and the latter are ideally suitable for removing casualties from inaccessible places.



## TRANSPORT

The transport requirements are of three types—Transport for carrying patients and transport for conveying mobile medical teams, and Tankers for transporting safe and potable drinking water.

### 1. Patient-carrying vehicles:

**Motor Ambulances:** Provision of sufficient number of motor ambulances and improvised motor-ambulances should be made for positioning at vulnerable hospitals/primary health centres and selected nodal places for evacuation of the seriously injured and the ill. Pre-fabricated modification kits for conversion of lorries and trucks for fitment of stretchers should also be stock-piled at selected hospitals and primary health centres.

### 2. General Service Vehicles: Light general service vehicles with high chassis and 4×4 drive should be provisioned in advance for conveying the mobile medical teams to the disaster affected areas.

### 3. Water Tankers: Sufficient number of water tanker should be provisioned in advance for transporting potable drinking water to distant and isolated places.

## ALTERNATE ACCOMMODATION FOR SHIFTING MEDICAL CENTRES

Vulnerable medical buildings of primary health centres Tahsil/Sub-divisional hospitals likely to get damaged are required to be shifted at short notice to suitable alternate buildings and such building should be pre-selected and earmarked in advance for providing in-patient medical care for the disaster victims. Likewise, sites/buildings for housing the static first-aid posts, temporary dispensaries and field hospitals should also be selected and earmarked for the purpose.

## HOSPITAL DISASTER CONTINGENCY PLAN

1. The hospital planning for emergency treatment of disaster victims should aim at maximum utilisation of the available facilities in the event of disasters. The staff both medical and para-medical, of the smaller hospitals at Tahsil Headquarters level in the disaster affected areas should be augmented by additional staff with the medical equipment from the non-affected areas, if necessary, in order to cope up with extra load of casualties and patients. Such reinforcement of staff and

equipment should be earmarked in advance and should be capable of being moved at short notice.

2. Reserve bed-steads, mattresses, bed linen and patients' clothing should be stock-piled in pre-selected hospitals and all available space (corridors, verandahs, waiting rooms and so on) should be earmarked for emergency expansion at short notice due to sudden influx of large number of casualties and patients.
3. Alternate sources of power and water supply should be planned and such facilities in the hospitals in earthquake-prone areas should be provided.
4. Voluntary Blood Transfusion Service: Even smaller hospitals at Tahsil level should be geared up with basic Blood Transfusion facilities in the earthquake-prone States. Blood Transfusion Departments of the hospitals should enlist voluntary blood donors with detailed particulars of the each donor. They should gear up a dependable system for call up of voluntary blood donors as and when required.

#### ASSISTANCE FROM ARMED FORCES MEDICAL SERVICES

Deployment of Armed Forces Medical Teams in the inaccessible areas and aerial evacuation of casualties from such areas should be planned in advance. Supply of essential medicines, etc. by air and movement of civil medical and para medical personnel by helicopters should also be planned in case of damage to surface routes—both rail and road.

#### COORDINATION OF VOLUNTARY RELIEF ORGANISATION

Enlisting the voluntary relief organisations for health and medical relief and coordinating their activities allocating specific areas of operation should be planned in advance in order to avoid duplication of relief and over-lapping of areas of activity.

#### COMMUNICATIONS

Advance planning of practical and workable net-work of communications should be undertaken in cooperation with Civil Defence, Police and other organisations to facilitate effective co-ordination with the medical and health authorities at different levels and also the concerned departments engaged in other relief activities.

## DOCUMENTATION

At all levels, documentation pertaining to casualties should be pre-planned and should be undertaken as correct as possible.

## REHEARSAL OF THE CONTINGENCY PLANS AT ALL LEVELS

Periodical rehearsals should be carried out and all aspect of the contingency plan should be tried out at all levels. The serviceability of the stock-piled equipments should also be checked during such occasions. Coordination with the Rescue Organisations for effective deployment of first-aid teams and also Mobile Surgical Teams should be rehearsed.

## EARTHQUAKE DISASTER MITIGATION

Disaster mitigation following an earthquake is undertaken by effective implementation of various aspects of contingency planning at different levels. Immediately after the impact of earthquake in a particular area of a State/Union Territory, a prompt reconnaissance of the affected areas, evaluation of the medical and health problems and proper assessment of requirements should be undertaken by the administrative medical authorities at all levels and the information thus collected and evaluated should be communicated to the next superior authority. For effective disaster mitigation, the emergency medical and health care measures for the affected population should be coordinated with other departments undertaking various types of relief activities. Disaster medicine consists of providing the affected population, in the first place, rapid and efficient emergency medical care on a large scale to ensure survival and comprehensive health care to prevent outbreak of epidemics.

## FIRST-AID DURING EVACUATION

Mass evacuation of affected population rendered homeless is undertaken immediately after the earthquake. First-aid parties may be provided depending upon the size of population to be evacuated. The number of first-aid parties should commensurate with the population to be evacuated. In addition, safe removal of the people unable to take care of themselves such as the infirm, the old, the expectant mothers in advance stage of pregnancy and the infants, should be undertaken under medical supervision and an Auxiliary Nurse Mid-Wife (ANM) should also be included in the first-aid team for evacuation of such section of population.

## FIRST-AID AND EMERGENCY LIFE AND LIMB SAVING SURGERY DURING RESCUE OPERATIONS

Immediately after the impact of earthquake and land slides, large number of casualties occur as a result of the collapse of roofs and walls of the buildings, impact against stationary objects and fallen trees and rolling rocky debris and electrical fire. These casualties likely to sustain severe injuries and burns, are required to be rescued by specially trained and properly equipped rescue personnel and to be rendered necessary first-aid immediately on the spot. Some of the major injury cases and trapped casualties may need emergency life and limb saving surgery for extrication from heavy debris and sometimes after extrication and for this purpose, deployment of mobile surgical teams along with Mobile Operation Theatre Complex will be desirable.

## FIRST-AID TO THE POPULATION IN THE ISOLATED AREAS AND POPULATION ON THE MOVE

First-aid posts should be established in isolated villages and groups of hamlets for rendering first-aid to the injured, and treatment of common minor ailments. In addition, first-aid posts are also required to be established in the lines of communications along which the population rendered homeless, trek towards the neighbouring villages and towns and this moving population is attended to by the first-aid teams of the static first-aid posts for minor injuries and ailments. The manpower for the first-aid teams for rescue, evacuation, and first-aid posts can be drawn from Civil Defence personnel and Home Guards.

## TEMPORARY DISPENSARIES IN TOWN AND VILLAGES WITH MIGRATED POPULATION AND IN EVACUEE CAMPS

The population of some of the large villages and towns is increased enormously by sudden influx of people from the neighbouring disaster affected areas. Temporary dispensaries should be set up in these places for coping up with the increased population. These dispensaries should be staffed by doctors and para-medical personnel on shift duties round the clock. Minimum laboratory facilities should be set up at these dispensaries for blood examination for malarial parasites in all cases of fever. Such dispensaries are also required to be established in the evacuee camps for the medical care of the evacuees.

## MOBILE MEDICAL TEAMS

Mobile Medical Teams manned by doctors and para-medical personnel should be allotted sector-wise in the earthquake and landslide affected areas for necessary medical and health relief measures for the

population of isolated and widely scattered villages and hamlets. The teams should be fully mobile in suitable vehicles with high chassis and 4×4 drive for facilitating cross-country capability. The evacuation of the seriously ill and injured and expectant mothers in labour is also undertaken by the mobile medical teams. The frequency of visits of the mobile teams largely depends upon the professional necessity. Besides affording medical and health care to the isolated population, they will also replenish the essential medicines and dressings expended in the static first-aid posts.

### **MEDICAL TEAMS OF THE ARMED FORCES**

Some of the towns, villages and hamlets remain inaccessible for considerable time with vast areas of devastation and the disaster stricken population are left unattended due to damaged/blocked rail and road communications. In such difficult circumstances, medical and health relief can be effectively instituted by deployment of medical teams of the Armed Forces by helicopters. Air evacuation of the seriously ill and the injured from the earthquake and landslide stricken areas can also be undertaken direct to the mobile field hospital if established or to the hospitals where necessary facilities or definitive treatment are available.

### **MOBILE FIELD HOSPITALS**

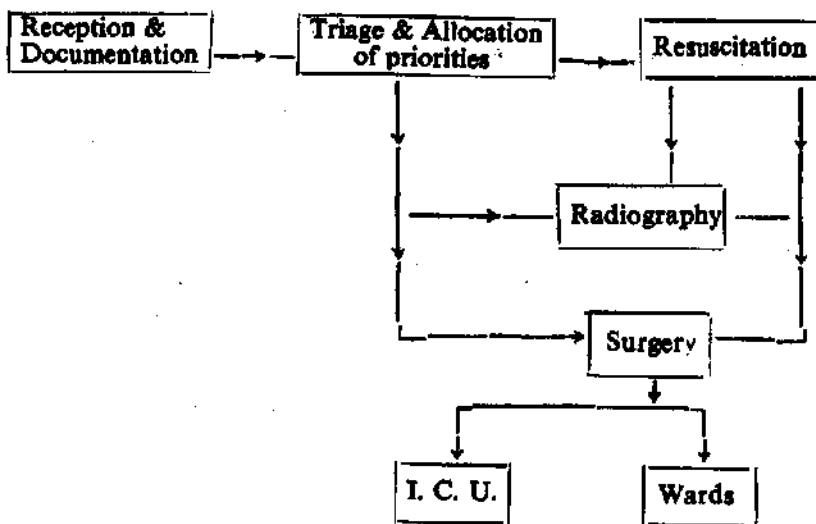
These mobile hospital may be established whenever mobile surgical teams are deployed for immediate hospitalisation of the cases after emergency life and limb saving surgery. Such hospitals may also be set up for indoor treatment of large number of cases of acute gastro-enteritis and also for isolating cases of infectious diseases if occurred in the evacuee camps. In cases the local hospitals are severely damaged, mobile field hospitals should be opened up for providing in-patient treatment facility for treatment facility for the local population.

### **EMERGENCY HOSPITAL SERVICE**

1. A fool-proof method of harnessing all the available manpowers of the hospital at short notice should be worked out and the orders issued for execution in the event of an emergency.
2. 50% of the beds should be kept vacant for receiving disaster victims by discharging cases of cold surgery and convalescent cases.
3. Only seriously-ill cases will be admitted as in-patients and

routine cases will not be admitted for ensuring required number of vacant beds for the disaster victims.

- The casualty department of the hospitals, however, small should be properly organised for receiving large number of casualties at short notice. The following procedure is suggested for ensuring smooth flow of casualties received in the hospital:



- Enquiry and Public Relation Office should be organised for giving necessary information required by the relatives of the casualties admitted into the hospitals.
- Major cases of injury such as orthopaedic cases, head injuries, etc. should be further evacuated after their condition is stabilised to the nearest medical college hospital where necessary facilities are normally available for definitive treatment of such cases.

## EMERGENCY HEALTH CARE

The essential ingredients of Emergency Health Care are as follows:

- Supply of safe and potable drinking water;
- Environmental Sanitation of the Evacuee Camps;
- Disposal of human dead and animal carcasses;
- Food Sanitation;
- Education of disaster victims in sanitation;

6. Epidemiological Surveillance;
7. Anti-fly Measures;
8. Anti-mosquito Measures;
9. Disinfection;
10. Mass-Immunisation;
11. Nutritional surveillance and feeding programmes for vulnerable population (pre-school children, expectant and nursing mothers) and cases of malnutrition.

## SUPPLY OF SAFE AND POTABLE DRINKING WATER

As a results of the earthquakes both urban and rural drinking water supplies get contaminated and become unsafe for human consumption. It is, therefore, essential that drinking water is effectively purified and rendered safe and potable for human consumption as a preventive measure against out-break of epidemics of water borne diseases. Chlorination is by far the most common and effective means of disinfection of drinking water and is undertaken by addition of requisite quantity of bleaching powder manually. The available chlorine in bleaching powder should be not less than 25%. With the passage of time and exposure to atmosphere, the available chlorine content decreases gradually. It is, therefore, necessary that bleaching powder should be kept in air-tight containers.

## VIROLOGICAL AND BACTERIOLOGICAL ASPECTS OF CHLORINATION

Presence of 0.5 mg/litre (0.5 ppm) of free chlorine residual for one hour or above is required to inactivate infectious hepatitis virus even in water that was originally polluted. This free chlorine residual is to be insisted at the source of supply at the water headworks and zonal reservoir and persistence of 0.2 mg/litre (0.2 ppm) of free chlorine residual should be ensured at the consumers end as all times. In case of occurrence of cases of infectious hepatitis in the wake of earthquake, the affected population should be advised to boil drinking water preferably, prior to its consumption.

## URBAN WATER SUPPLY

The damage to the urban water supply system is caused by ground shaking, faulting, slope failure, landslide, local settlement, liquefaction and power failure. Cross contamination of the drinking water supply might occur due to broken underground piped drinking water system and sewage system. After carrying out the necessary repairs and

restoration of power supply, the entire water supply system should be disinfected with bleaching powder solution of 50 mg/litre for a contact period of 24 hours after which the main distribution pipes should be emptied and flushed again with potable water. After the disinfection operation but before the drinking water mains are put back into the service, samples of water should be taken for bacteriological analysis and determination of free chlorine residual (0.2 ppm) at the consumers' end should be undertaken for ensuring safety and potability.

## RURAL WATER SUPPLY

The wells are the main source of drinking water in rural areas, get grossly contaminated as a result of earthquake by infilling with sand and overflowing from their tops. The casing of the tube well get sheared of below the ground level and it is impossible to rebores them after the earthquake, thus resulting in abandonment of some of the wells.

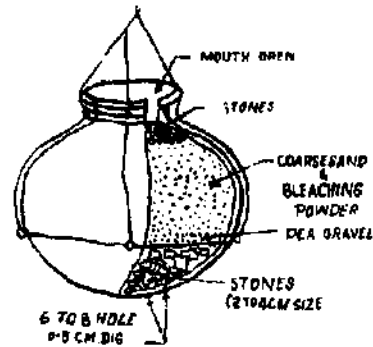
The following methods are recommended for disinfection of wells:

### CONTINUOUS CHLORINATION

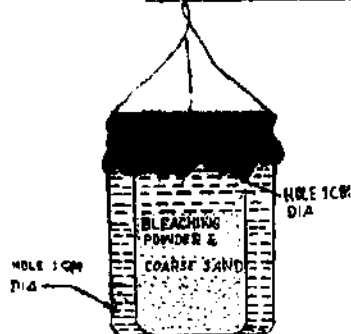
Single and double pot methods of chlorination evolved by National Environmental Engineering Research Institute, Nagpur (India) for disinfecting well waters are considered very effective for sustained chlorination for a period of 10-12 days (Fig.8). However, these methods are not likely to work effectively in wells containing hard water.

### INTERMITTENT CHLORINATION

Purification of contaminated well waters can also be undertaken by conventional method of chlorination by adding the requisite quantity of bleaching powder manually. Prior to disinfection of the wells, the existing volume of water in the wells and the yield of the wells in 24 hours should be estimated. The dosage of bleaching powder may be determined by conducting Harrock's test and



Single Pot System of Chlorination of Wells



Double Pot System of Chlorination of Wells

Fig. 8.



the safety and the potability of the drinking water supply should be ensured for presence of 0.2 ppm of free chlorine at all times by conducting orthotolidine test.

Very often a large proportion of the earthquake stricken victims take to temporary shelters provided by the State Government or Voluntary Agencies or erected by themselves and the drinking water supply is provided by sinking hand-pumps which draw shallow well waters. The water thus drawn by hand pumps into domestic utensils is contaminated and should, therefore, be disinfected by halogen/chlorine tablets. The dosage of tablets depends upon the volume of the utensils and a contact of 30 minutes should be ensured prior to consumption.

### **ENVIRONMENTAL SANITATION OF EVACUEE CAMPS**

The evacuee camps are normally established in temporary shelters or built-up areas such as school/college buildings, community halls and so on, depending upon the local situation. The evacuee camps should be provided with the following basic sanitary facilities in order to ensure optimum environmental sanitation to prevent out-break of epidemics.

#### **TEMPORARY URINALS**

Adequate number of funnel type of temporary urinals with soakage pits should be constructed separately for men and women with screens for providing privacy. (Fig. 9 & 10). While siting urinals, prevailing winds should be taken into consideration and should be away from the cook houses and dining places.

#### **TEMPORARY LATRINES**

If the duration of the stay in the evacuee camp is expected for more than 7 days, the night-soil should be disposed off by construction of deep trench latrines, (Fig. 11A, 11B, 12A, 12B and 12C), bore-hole latrines or hand flush latrines with water seal at the scale of 8-10 seats per 100 persons. They should be constructed for men and women separately.

#### **DISPOSAL OF CAMP DRY REFUSE**

The camp dry-refuse should be disposed off by incineration utilising inclined plane incinerators or open or semi-closed incinerators (Fig. 13 and 14). The incinerators should be located far away and down wind from the camp.

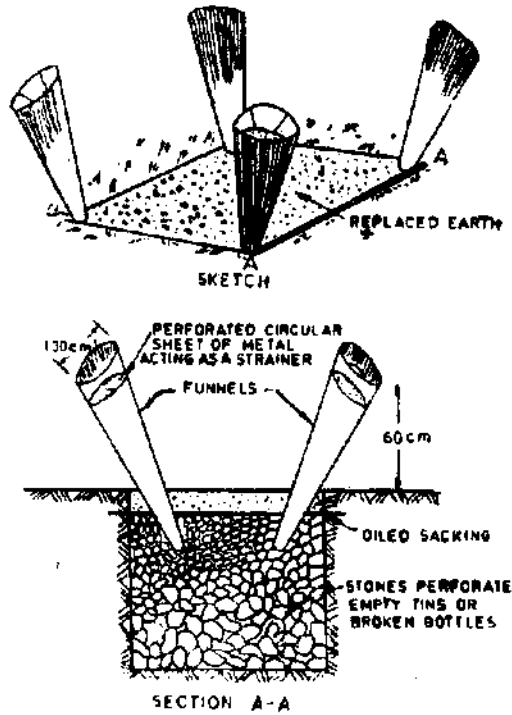


Fig. 9. Funnel Urinals for males with Soakage Pit.

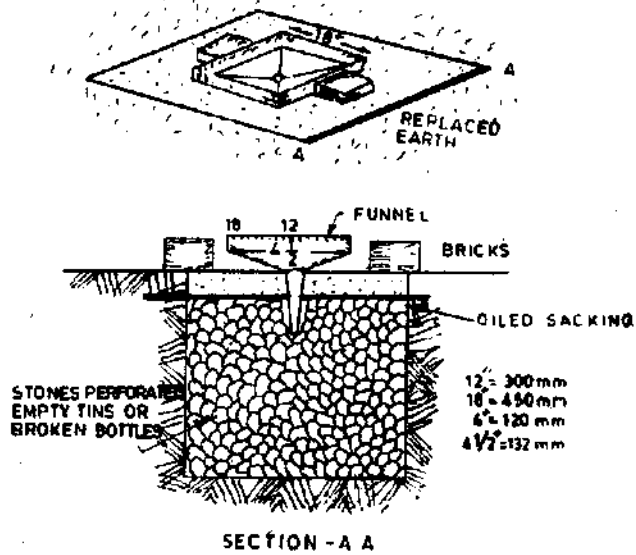


Fig. 10. Shallow Funnel Urinal for Ladies with Soakage pit.

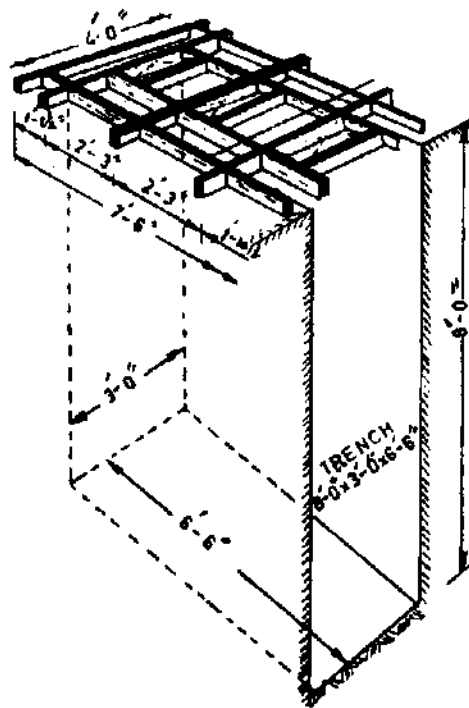


Fig. 11a. Wooden Framework of Deep Trench Latrine.

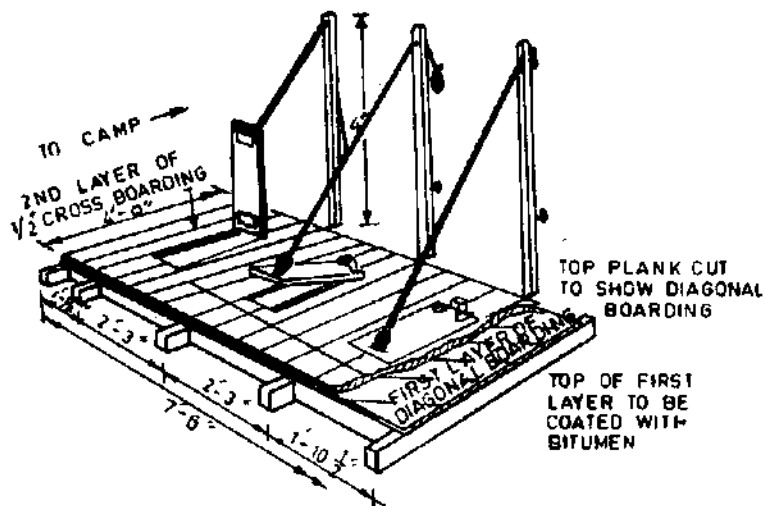


Fig. 11b. Superstructure of Deep Trench Latrine.

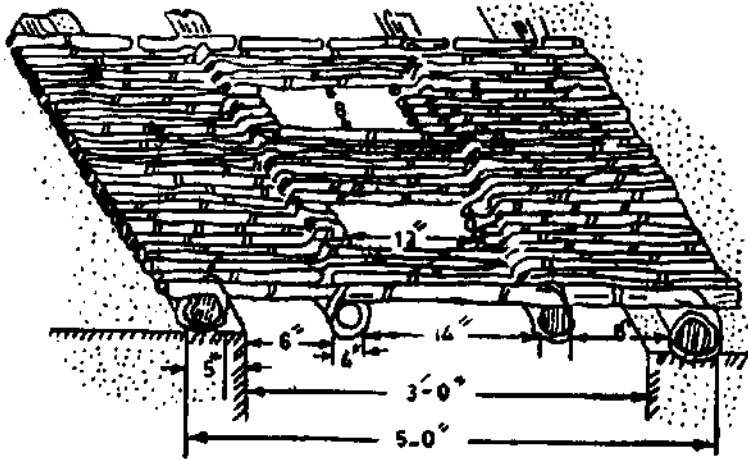


Fig. 12a. Deep Trench Latrine Cover made of Bamboo covered with oiled (stacking) Hessian Cloth.

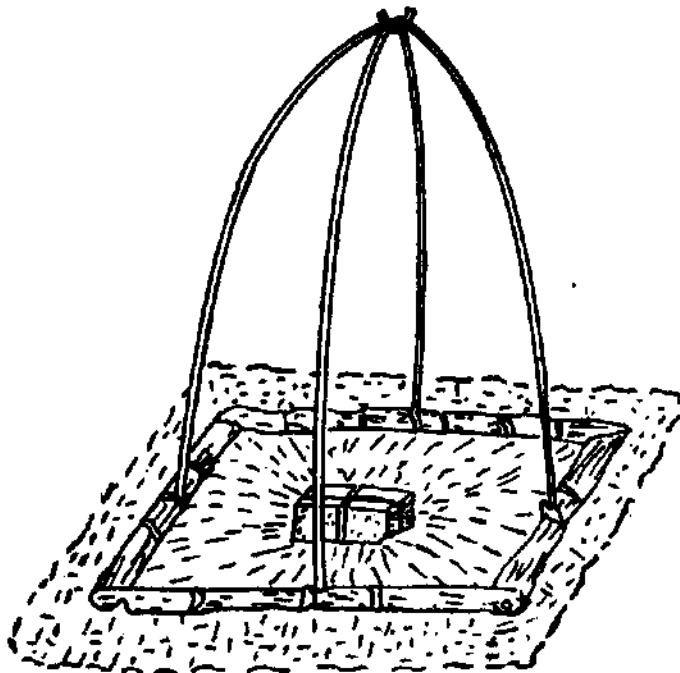


Fig. 12b. Cover for Squatting Opening Made of Bamboo Covered (in sacking) by Oiled Hessian and weighted with a Brick .

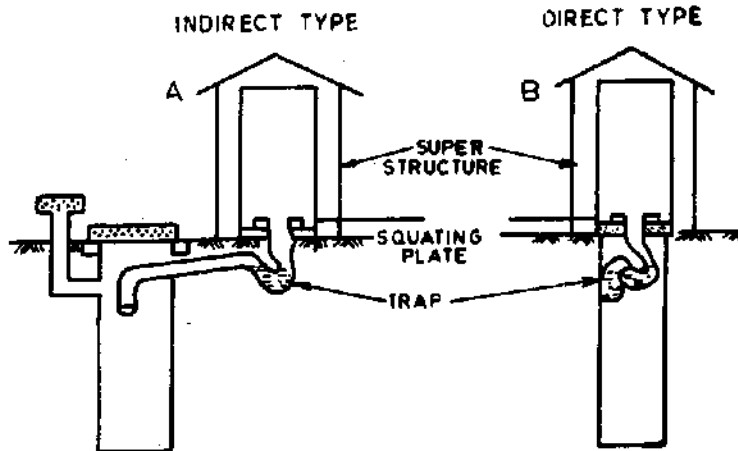


Fig. 12c. Hand-flush Latrines.

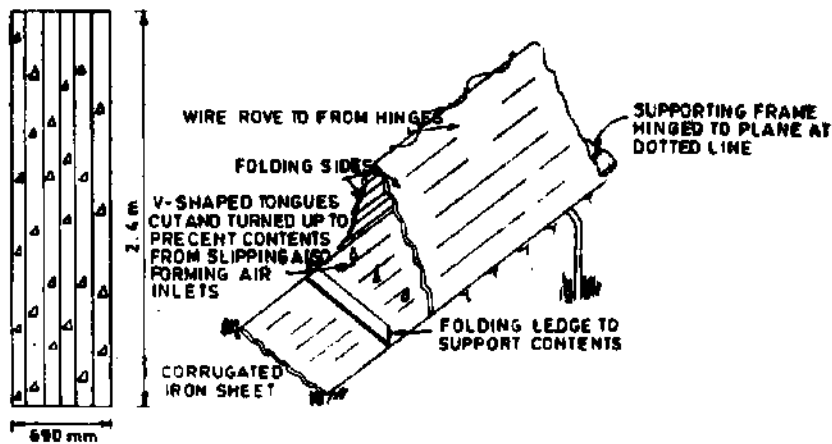


Fig. 13. Portable inclined plane incinerator.

## BATHING CUBICLES

Adequate number of bathing cubicles separately for men and women should be provided with screens to ensure privacy. Effective drainage of the waste water from the bathing cubicles be provided to prevent water-logging and mosquito breeding.

## COOK-HOUSES

Cook house sanitation should be observed meticulously in respect of fly-proofing by utilising local materials and personal hygiene of the

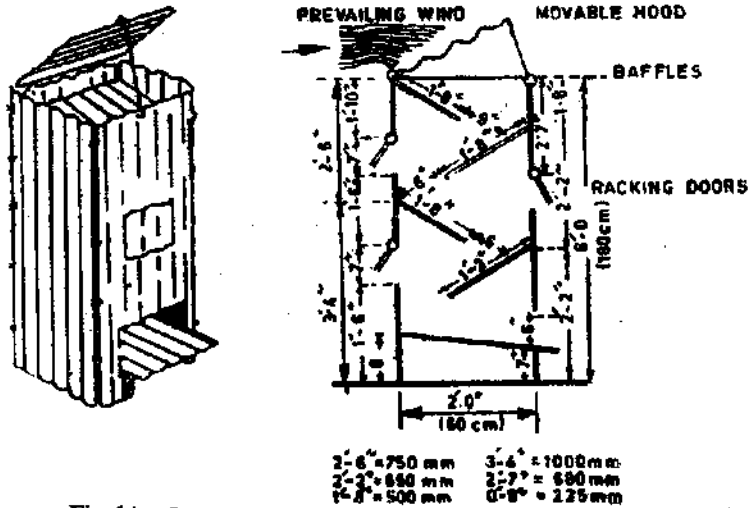


Fig. 14. Semi-closed rectangular corrugated iron incinerator graduated feed.

cooks and the food handlers. The cook house should be sprayed daily with 0.1 per cent pyrethrum solution and weekly with 5 per cent DDT suspension to prevent fly nuisance. The sullage water from the cook houses should be drained into a soakage pit after allowing it to pass through strainer grease trap (Fig. 15) for removing the suspended matter and grease.

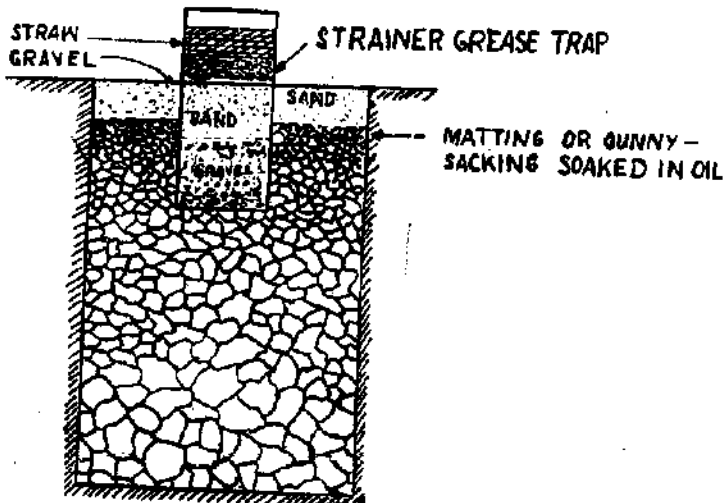
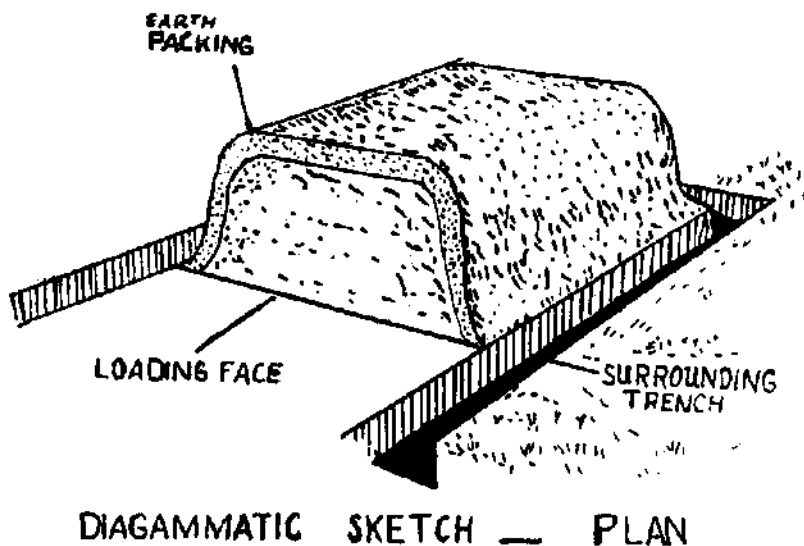


Fig. 15. Straining Grease Trap with Soak Pit for kitchen sullage.

## DISPOSAL OF ANIMAL MANURE

Animal manure is ideal breeding ground for flies; hence it should

be collected daily and finally disposed off by tight packing (Fig. 16) or trenching/composting.



DIAGAMMATIC SKETCH — PLAN

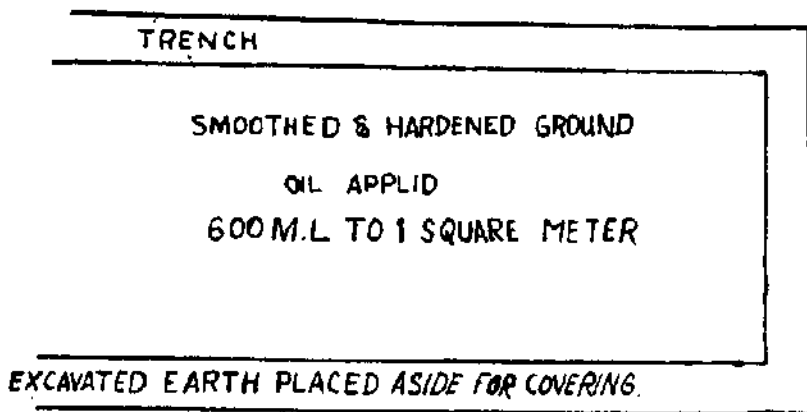


Fig. 16. Tight Packing of manure.

## DISPOSAL OF THE HUMAN DEAD AND ANIMAL CARCASSES

The removal and disposal of the dead bodies from the scene of the disaster is not the responsibility of the sanitation personnel. This task should be undertaken by the Corpse Disposal Squads of the Civil Defence and Home Guards Organisation. The voluntary social service organisations should also render necessary assistance in this task. However, the sanitary staff is required to supervise the disposal when the deaths are due to epidemics.

Efforts should be made to identify the dead bodies or at least to obtain all possible information. An identity tag should be fixed to the

body and all available information recorded in a separate register to be maintained for the purpose. The establishment of the legal proof of deaths is the responsibility of the medical examiner who issues the death certificate. The next of kin should receive the valuable personal effects of the dead and if claimed should be handed over to the relatives. In the event of epidemics, personal belongings should be disinfected before they are returned. The personnel engaged in the disposal should have special working clothes, rubber gloves and masks which should be disinfected after their use at the end of a day's work. The personnel should wash themselves thoroughly with a suitable disinfectant and soap.

The human dead should be removed and cremated/buried at the earliest in order to maintain morale of the affected population and general public.

As regards the animal carcasses, charring should be done early after the death of the animals so that saprophytic organisms have no time to penetrate tissues and is done by spreading 20 Kg. of dried grass or litter soaked with kerosene oil over each carcass and igniting the same. The aim is to sterilise the surface by charring and not to incinerate. The exposed surface affords no attraction to flies. Alternatively, a disinfectant fluid consisting of part of coaltar creosote oil with 14-18 per cent tar acids and 5 parts of kerosene may be sprayed over the carcasses in order to prevent offensive odour and fly breeding and to protect them from predatory animals. 8 litres of this disinfectant is required per each animal carcasses. A spray of 5 per cent creosote can also be used. Afterwards, the carcasses may be buried for their final disposal. A single cattle-head needs  $4 \times 2 \times 2$  metres pit approximately. A large pit is required to bury number of carcasses. Before the carcasses are placed in the pit, their bellies and intestines should be opened to permit the gases of decomposition to escape. Otherwise the bodies swell enormously and often force open the earth. Burial places should always be remote from the drinking water wells. Slaked lime (but not bleaching powder) should be sprinkled over the carcasses in the pit and over the area. If sufficient fuel is available readily, the carcasses may be burnt to ashes.

### FOOD SANITATION

Food stalls, restaurants, warehouses and the like are frequently destroyed or damaged in an earthquake disaster and much deterioration and spoilage of stored food stuffs is to be expected. The interruption of electric power supply may affect the operation of refrigerators and cold storage plants which also contributes to additional wastage of food.

Under emergency conditions food inspection will have to be based on the appearance, physical condition, smell and taste of food stuffs



in relation to normal characteristics and keeping quality. Careful examination is required to determine whether food is infected and unfit for human consumption, impaired but still useable for certain purposes such as animal feeding or completely spoiled requiring immediate safe disposal.

The preventive and control measures that can be applied in order to ensure good food sanitation include the following:

1. Milk must be boiled.
2. Consumption of commercial ice should be prohibited.
3. Uncooked vegetables and fruits which are customarily eaten unpeeled should be washed and soaked in solution made by adding 3 scoop-ful or 6 grams of bleaching powder to a bucket-ful of water before peeling. The sale of cut-fruits and vegetables should be prohibited.
4. All food must be protected against flies.
5. Strict supervision of kitchen sanitation is necessary to ensure that food is prepared, cooked and served under clean conditions.
6. Proper medical examination and personal hygiene of cooks and food handlers should be insisted upon and adequate washing and sanitary facilities should be provided to them.

### EDUCATION OF DISASTER VICTIMS IN SANITATION

Education in sanitation should be imparted again to the disaster victims after the impact of an earthquake. The affected population should be re-educated on the importance of safe and potable drinking water and simple methods of rendering drinking water safe and potable. Further, education should be imparted in the proper use of field sanitary engineering devices such as temporary urinals and temporary latrines and community participation in maintenance of optimum environmental sanitation. The affected community should participate and involve themselves actively in anti-fly measures instituted by Governmental and voluntary relief organisations.

### EPIDEMIOLOGICAL SURVEILLANCE

The health teams augmented by personnel of the cholera combat teams and National Malaria Eradication Programme should be deployed in disaster affected zones, and evacuee camps in order to investigate any

rumours of unusual disease occurrence besides monitoring cases of gastro-enteritis and cholera and carrying out both active and positive malaria surveillance. In addition, a dependable system of regular data reporting and collection regarding the incidence of diseases from the various medical aid posts—temporary and permanent and rapid analysis should be established in order to identify out-break of diseases. Culturing of samples collected in the outbreak has priority over routine tests. Potential diseases should be detected by reporting clinical symptoms. Generally, the major function of the surveillance system is to reassure the population and to direct part of the relief effort to more productive tasks. The success of the surveillance system instituted in the past suggest that immediate use of epidemiological methods should be an integral part of the disaster relief.

### ANTI-FLY MEASURES

The flies thrive in insanitary conditions and are very effective agents in spreading water-borne diseases. While controlling fly nuisance, high standard of environmental sanitation of the disaster affected areas especially evacuee camps should therefore be ensured, besides instituting anti-fly measures. It is easier to prevent fly breeding than killing adult flies.

### PROVENTION OF FLY BREEDING

Fly breeding should be prevented by persistent and vigorous efforts in maintaining high standard of environmental [sanitation by proper disposal of human and animal excreta, garbage, decaying organic rubbish and carcasses.

### DESTRUCTION OF ADULT FLIES

Destruction of adult flies should be vigorously undertaken as a supplementary measure by regular use of insecticide spray of organo-phosphate/DDT/BHC/Chlordane. Anti-fly mixture of 0.1% Pyrethrum and DDT 5% in kerosene is extremely effective. Spraying of anti-fly mixture should be undertaken in the cook houses, dining places, garbage bins, manure dumps and latrines.

### DISINFECTION

As a result of earthquake disasters there is usually increase in water-borne diseases such as diarrhoeas, dysenteries and gastro-enteritis. Further, the incidence of cholera tends to get accentuated in cholera endemic areas. It is therefore desirable that both concurrent and terminal

disinfections should be carried out methodically in order to prevent their spread and out-break of epidemic among the disaster victims.

### MASS IMMUNISATION

**Cholera.** Immunisation against cholera confers protection for 3-6 months after which re-inoculation is needed. However, the value of immunisation within that limit has been established statistically and epidemiologically. The anti-cholera vaccine manufactured in India contains E1 tor component. It has withstood trials as to its specific value in control of outbreak of epidemics.

### ENTERIC GROUP OF FEVERS

Protective immunisation has proved the most important and effective single preventive measure in the control of enteric group of fevers.

Mass immunisation programme in disaster affected population against cholera and typhoid fever should be undertaken by utilising pedo-jet vaccination injector guns which not only facilitates inoculation at a faster rate in a shorter time but also obviates the risk of serum hepatitis and the pain associated with injection by the conventional methods.

### INFECTIOUS HEPATITIS

Immunisation against infectious hepatitis on a mass scale is very expensive and therefore it may be restricted to the contacts only and may be undertaken by administering immune gammaglobulin especially for the control of incidence in the families.

### TETANUS

Tetanus anti-toxin should be given prophylactically to all individuals at risk with infected wounds, wounds contaminated with soil or mud, lacerated or punctured wounds and wounds with devitalising tissue damage. A dose of 1500 International Units should be given subcutaneously or intramuscularly as early as possible after the wound is received. In severe wounds, the dose may be doubled or trebled and the anti-toxin injected around the wound. In all cases of anti-toxin prophylactic administration, due precautions must be taken against possible allergic reactions as some individuals are likely to be sensitive to equine serum.

In addition to passive immunisation, active immunisation should also be undertaken by administration of 1.0 ml. of tetanus toxoid

repeated again by administration of 1.0 ml. after a period of 6 weeks in non-immunised individuals. However, in individuals who are already immunised a booster dose of 1.0 ml. of tetanus toxoid should be administered.

#### **DOG BITES**

It has been reported and also observed that the dogs get irritable after major disasters like severe earthquakes. The strange behaviour of the dogs might be attributable to the sudden change in the surrounding environmental conditions and loss of their masters in the case of pet dogs. Further, both the population rendered homeless and the stray starving dogs are brought closer due to disaster circumstances. Preventive immunisation against rabies should be undertaken in all cases of dog-bite by administration of anti-rabic vaccine although no cases of Rabies have been reported. The actual dosage and the period of preventive immunisation depends on the age of the individual, the site and the severity of the wounds. In the case of dog-bites over neck and above, lacerated wounds and multiple bites, preventive immunisation may be supplemented by passive immunisation with local application and infiltration of 5 ml. hyper-immune anti-rabic serum underneath and around the bites.

#### **SNAKE BITES**

In the case of snake bites lyophilised polyvalent antsnake venom serum should be administered as early as possible. As first dose atleast 20 ml. of reconstituted serum should be injected intervenously; second dose should be repeated 2 hours after the first dose or even earlier if the symptoms persist. This anti-snake serum is effective against venoms of 4 common poisonous snakes in the country, viz., Cobra, Common Krait, Russell's viper and saw-scaled Viper. In the case of viper, some serum should also be injected around the site of the bite to prevent gangrene which otherwise results in very destructive effect of localised viper venom on the tissues.

#### **NUTRITIONAL STATUS SURVEY AND FEEDING PROGRAMME FOR THE MAL-NUTRITION CASES AMONGST CHILDREN, EXPECTANT AND NURSING MOTHERS**

Mal-nutrition specially in the vulnerable segments of the population namely pre-school children, expectant and nursing mothers is a commonest sequela in many natural disasters in our country. Population groups living in border levels of nourishment would be susceptible to mal-nutrition even by minor calamities and scarcity conditions for short duration.

Common manifestations of mal-nutrition are protein-energy mal-nutrition resulting in marasmus and Kwashiorkor in pre-school children, famine oedema in adults, Vitamin 'A' and 'B' Complex deficiencies, and anaemia. Apart from the common causal factors of poverty, poor personal hygiene and low standard of environmental sanitation, nutritional deficiency increases the susceptibility to more frequent infections—particularly gastro-intestinal and respiratory infections which tend to run a more severe course, resulting in increased morbidity and mortality especially in infants. It is, therefore, necessary that nutritional status survey should be conducted in the disaster affected areas and evacuee camps and appropriate feeding programmes should be instituted by coordinating the activities of various agencies—State Government and Voluntary Organisations engaged in nutritional programmes.

### PSYCHOLOGICAL CARE

Sometimes an earthquake provokes reactions such as psychosomatic ailments; conversion reactions may occur which lead to the sudden loss of some important function (such as speech) or cause the patient to forget traumatic experience—despite the absence of any organic lesion.

Depression, which causes people to act confused or behave indifferently to their surroundings, is also a common phenomenon. In this case, however, immediate treatment gives excellent results; in fact, a mere show of interest in the affected individual can often evoke a positive response. Therefore, by way of effective therapy, it is useful to tranquilize depressed subjects and to seek their cooperation in carrying out certain simple tasks relating to their accustomed duties.

Hyperactive responses may also occur which prompt affected subjects to become intensely and abnormally active. This response may seem useful at the time, but it is also true that those affected can become disturbing influence or can serve as nuclei for collective panic. Therefore, those who react to an earthquake with excessive activity should be assigned manual tasks; this will turn them into useful workers while giving them a good outlet for the energy resulting from their emotionally disturbed state.

Sometimes, the earthquake victims are affected by panic, i.e., acute fear with flight or attempted flight and is experienced when (1) an immediate danger is perceived to be present, (2) from which an individual sees his escape routes blocked (or closing rapidly by other accounts), and (3) feels highly isolated.

Most authors who have studied the psychological effects of natural calamities have not observed severe mental disorders (psychoses) among the victims. Those that have been observed were benign and transitory, and were preceded by earlier psychological disturbances in most cases.

To sum up, most people affected by an earthquake gain control of themselves in a reasonable time and need no special psychiatric care. Psychological assistance is needed only for those who have clearly lost control of themselves and who show no progress towards achieving normal behaviour.

Because of the psychological considerations involved, it is advisable to deploy at least one mental health team. This team composed of psychiatrists, psychologists, health educators, and social workers should be sent into the disaster area on a third priority basis to assist with mental recovery of the population, to provide re-education for adjustment to new circumstances, and to help organise the people for a new community life.

The professional personnel of Search and Rescue Teams/Task Forces and Medical and Para-medical personnel, etc., who are required to report to their respective organisations immediately after the impact, are often subjected to 'role conflict' between their job and status of the family-safe or injured, and find themselves in difficult situation to resolve.

With regard to outsiders, it is essential to realise that large numbers of people from the periphery of a earthquake area have a tendency to 'converge' towards the Centre. This phenomenon 'Convergence reaction' is the most difficult problem. After major disasters, few people flee from the impact zones; on the contrary, different types of people, returnees, worried persons like relations and friends volunteers and helpers, curious persons and exploiters converge towards the affected areas depending upon their motivation. This convergence reaction comprises people, supplies—at times use—less and unsolicited, and information and is the main cause of chaos and confusion.

## CONCLUSION

Effective earthquake management consists of (a) community earthquake disaster preparedness, and (b) contingency planning of anti-disaster measures prior to occurrence of earthquake and (c) post-disaster mitigation measures following the earthquake.

The vulnerable population should be educated on the earthquake

safety precaution which should be taken prior to, during and after the earthquake. Such awareness would minimise the mortality and morbidity due to injuries and disaster-associated health hazards. Community participation by way of Village Volunteer Force should be raised for instant deployment for rescue, first-aid and relief operations, debris clearance, disposal of human dead, etc.

Task Forces comprising properly trained and adequately equipped personnel should be raised and positioned at nodal places for undertaking organised, skilled rescue operations immediately after the earthquake in order to save more number of people, reduce human suffering and distress and minimise residual incapacity.

Contingency planning of anti-disaster measures by the Medical and Health Services of the State Governments at all administrative levels by way of (a) harnessing additional medical and para-medical and health personnel, (b) stock-piling of essential medicines, splints, dressings, disinfectants, emergency sanitation contrivances, (c) equipping with Mobile Operation Theatre Complexes for undertaking life and limb saving emergency surgery on the spot and (d) keeping 50-100 bedded Mobile Field Hospitals in readiness for deployment at short notice, (e) retro-modifying the hospitals for earthquake resistance and (f) earmarking suitable buildings for shifting the hospitals in case they are damaged. The various aspects of the contingency plan should be rehearsed and the plan should be updated.

Post-disaster mitigation measures should be undertaken immediately after striking of the earthquake by implementing the contingency plan after reconnaissance and evaluation of the nature and extent of the medical and health problems encountered.

In addition to the State Governments, Voluntary Organisations should play active role in community disaster preparedness, rescue and relief activities which should be coordinated by allocating specific sectors in order to avoid overlapping of areas and duplication of relief.

## REFERENCES

1. Learning from Earthquakes—Publication of Earthquake Engineering Research Institute, 424-40th Street, Oakland, CA 94609 USA (1977—Planning and Field Guides) Social Science Field Guide—The Reconnaissance Team for a Predominantly Urban Earthquake—Page 178, Lines 21 & 22.
2. Geological Survey of India—Preliminary Account of the Earthquake of the 15th Jan. 1934 in Bihar and Nepal by JB Auden and MN Ghosh. Volume LXVIII, Page 198.

3. **Manual of Health for the Armed Forces—1968** issued under the authority of Director General, Armed Forces Medical Services, Ministry of Defence, New Delhi. Pages 133, 161, 164, 172.
4. **Manual on water Supply and Treatment—2nd Edition**, issued by Ministry of Works and Housing in 1977, Page 187.