DISASTER MANAGEMENT PLAN AND STANDARD OPERATING PROCEDURES

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These guidelines are dedicated to our patients and other victims of disaster and trauma.

Regards,

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LIST OF ABBREVIATIONS:

SOP – Standard operating protocol

AIIMS – All India Institute of Medical Sciences

DRT – Disaster Response Team

DMP- Disaster Management Plan

DDA- Deputy Director Administration

SNO – Senior Nursing Officer

MS/ DMS- Medical Superintendent / Deputy Medical Superintendent

PRO – Public Relations Officer

OMFS – Oral and Maxillofacial Surgery

ATLS – Advanced Trauma Life Support

NDRF – National Disaster Response Force

BMW – Biomedical Waste

ICS- Incident Command System

HICS- Hospital Incident Command System

ER – Emergency room

FAST – Focused Assessment Sonography for Trauma

eFAST – Extended Focused Assessment Sonography for Trauma

ABG – Arterial Blood Gas

DPL – Diagnostic Peritoneal Lavage

IV – Intravenous

IM -Intramuscular

GCS- Glasgow coma scale

AIDS – acquired immunodeficiency syndrome

CDC – Centre for disease prevention and control

DISASTER AND TRAUMA

ABCDE – Airway, breathing, circulation, disability, exposure/environment

ED – Emergency department

CT – Computerized Tomography

USG - Ultrasonography

MRI – Magnetic Resonance Imaging

NEXUS - National Emergency X-Radiography Utilization Study

CCR – Canadian C spine Rules

PMRR – Preparedness, mitigation, response and recovery

AKI – Acute Kidney injury

RL – Ringer Lactate

NS- Normal saline

ARS – Acute radiation syndrome

DNS – Dextrose and Normal saline

MLC – Medicolegal case

PTSD – posttraumatic stress disorder

RTA- Road traffic accident

CMO- Casualty Medical Officer

ICU – Intensive Care Unit

CSSD- Central Sterile Services Department

TABLE OF CONTENTS:

1. AIMS:

i. To formulate a distinct DMP for AIIMS, Rajkot, which then shall be regularly practiced and implemented in the hospital.

ii. To develop an evidence-based and comprehensive manual with special focus on disaster prevention, preparedness and response so as to reduce the impact of both natural as well as man-made disasters on the society at large.

2. INSTITUTIONAL DRT:

2.1. Composition-

The DRT shall function under the chairmanship of the Executive Director, AIIMS Rajkot with a permanent membership of the representatives of the following departments:

- General Surgery
- Orthopaedics
- Anaesthesia and Critical Care
- OMFS

These members shall include one faculty and Senior as well as Junior residents from each of the above departments. In addition, Nursing officers and paramedical staff shall function on a rotation basis to support the trauma team from time.

Other departments and stakeholders such as sanitary, security and fire services, transport etc. shall have a broad membership and partake in related activities depending upon the prevalent scenario.

AIIMS RAJKOT DRT

- Chairman: Executive Director
- Permanent Members: Departments of Anaesthesia, Orthopaedics, General Surgery and OMFS, Emergency nursing and paramedic staff
- Other stakeholders:

i. Administration: DDA, Administrative Officer, Faculty (Hospital Administration)
ii. Finance and Accounts Officer
iii. Security and Fire services In-charge
iv. DMS
v. SNO (ER)
vi. Sanitary service In-charge
vii. Central Store In-charge
viii. Heads of Departments/In-charges: Medicine, Radiology, Obstetrics and Gynaecology, Paediatrics, Blood bank and Integrated Laboratory services
ix. Nodal Officer – NDRF (Saurashtra/ Rajkot area)
x. PRO (AIIMS, Rajkot)

2.2. Objectives-

i. To conceptualize SOPs for disaster response and ensure their implementation within the hospital premises.

ii. To regularly update the DMP to keep in sync with the latest guidelines

iii. To take the necessary measures and practices so as to ensure that AIIMS Rajkot is prepared to deal with any natural/man-made disaster

iv. To create awareness and engage institute faculty, residents, nursing and paramedical staff in regular training activities.

v. To liaison with other state and national level organizations e.g. NDRF, which have a similar mandate to plan and organize strategies and disaster response/preparedness tactics to ensure optimal response at the time of actual emergency.

vi. To build the requisite infrastructure and logistics to support unhindered operations at the time of disaster response.

3. DISASTER DESCRIPTION:

3.1. Understanding Disaster and disaster management-

The Disaster Management Act 2005 defines "disaster" as a *catastrophe, mishap, calamity or grave occurrence in any area, arising from natural or man-made causes, or by accident or negligence which results in substantial loss of life or human suffering or damage to, and destruction of, property, or damage to, or degradation of, environment, and is of such nature or magnitude as to be beyond the coping capacity of the community of the affected area*.

The same act defines Disaster management as *a continuous and integrated process of planning, organizing, coordinating and implementing measures which are necessary or expedient for-*

- *Prevention of danger or threat of any disaster;*
- *Mitigation or reduction of risk of any disaster or its severity or consequences;*
- *Capacity-building;*
- *Preparedness to deal with any disaster;*
- *Prompt response to any threatening disaster situation or disaster;*
- *Assessing the severity or magnitude of effects of any disaster;*
- *Evacuation, rescue and relief;*
- *Rehabilitation and reconstruction;*

3.2. Disaster Preparedness-

i. *Community preparedness*: Disaster preparedness (whether at the national/zonal/state or district level) requires close coordination between healthcare and government agencies such as police, fire etc. In addition, special needs population groups such as children, elderly, disabled people, the poor etc. pose unique challenges which need to be addressed at all levels.

There are two important terms which define a hospital's disaster preparedness – Surge Capacity and Surge capability. Surge capacity refers to the number of additional beds, personnel or equipment (such as ventilators) which can be pressed into service in the event of multiple casualties. Capability, on the other hand, indicates the number of additional machines which have qualified personnel to handle them or additional beds which can be staffed in order to care for the patients. ATLS guidelines recommend the Surge capacity to be set at 20% higher than the baseline.

ii. *Hospital preparedness*: This involves both disaster planning and training of healthcare personnel involved and should include the following steps:

- Make available effective means of communication such as pagers, walkie-talkies, on-call mobile phones etc. keeping in mind all contingencies such as loss of telephone landlines.

- Provide for storage of equipment, supplies or any other disposable that may be deemed necessary

- Have an arrangement in place for effective transfer of casualties/inpatients to other centers in case the present center becomes saturated/unusable

- Have a plan for mobilization of surge capabilities to care for both patients already in the hospital as well as incoming victims of trauma

- Provide training to all medical as well as non-medical personnel in disaster management.

- Mobilize the HICS to the predestined incident command center.

- Institute adequate security precautions including safety of all personnel involved.

- Prepare decontamination (if required), triage and treatment areas.

- Ensure a plan for unidirectional and seamless flow of patients from the ER to the inpatient departments

- Have a plan in place to isolate the hospital, including lockdown if necessary.

- Ensure supplies to establish at least 72 hours of unhindered hospital operations.

- Institute a public information center and provide regular briefings to the hospital personnel and families of the patients.

In addition, hospitals must also plan a number of ways in which healthcare providers are able to meet any specific family responsibility in the event of a disaster. Among these are assistance in identifying alternate resources for the care of dependents and help workers formulate a dedicated family disaster plan for themselves.

3.3. Mock drills and exercises –

There are mainly two types of disaster mock drills and exercises – (1) Tabletop exercises: These use written and verbal scenarios to assess a facility's overall disaster plan and preparedness. (2) Field exercises: Here real people and equipment is employed, either in an outdoor setting or in a specific hospital area.

3.4. Triage- (*discussed in detail in the next chapter*)

3.5. DMP-

3.5.1 Disaster prevention:

i. *Disaster Risk Reduction:* AIIMS Rajkot will undertake the following preventive measures to ensure reduced risk from natural and man-made disasters:

- Biological: Campus area will be regularly inspected so as to ensure safe and effective disposal of BMW and thus, prevent outbreaks of communicable diseases.

  Stakeholder: HICC and BMW committee, Sanitary Officer
- Radiation: Areas and healthcare staff exposed to radiation hazards shall be periodically monitored and appropriate measures will be taken from time to time

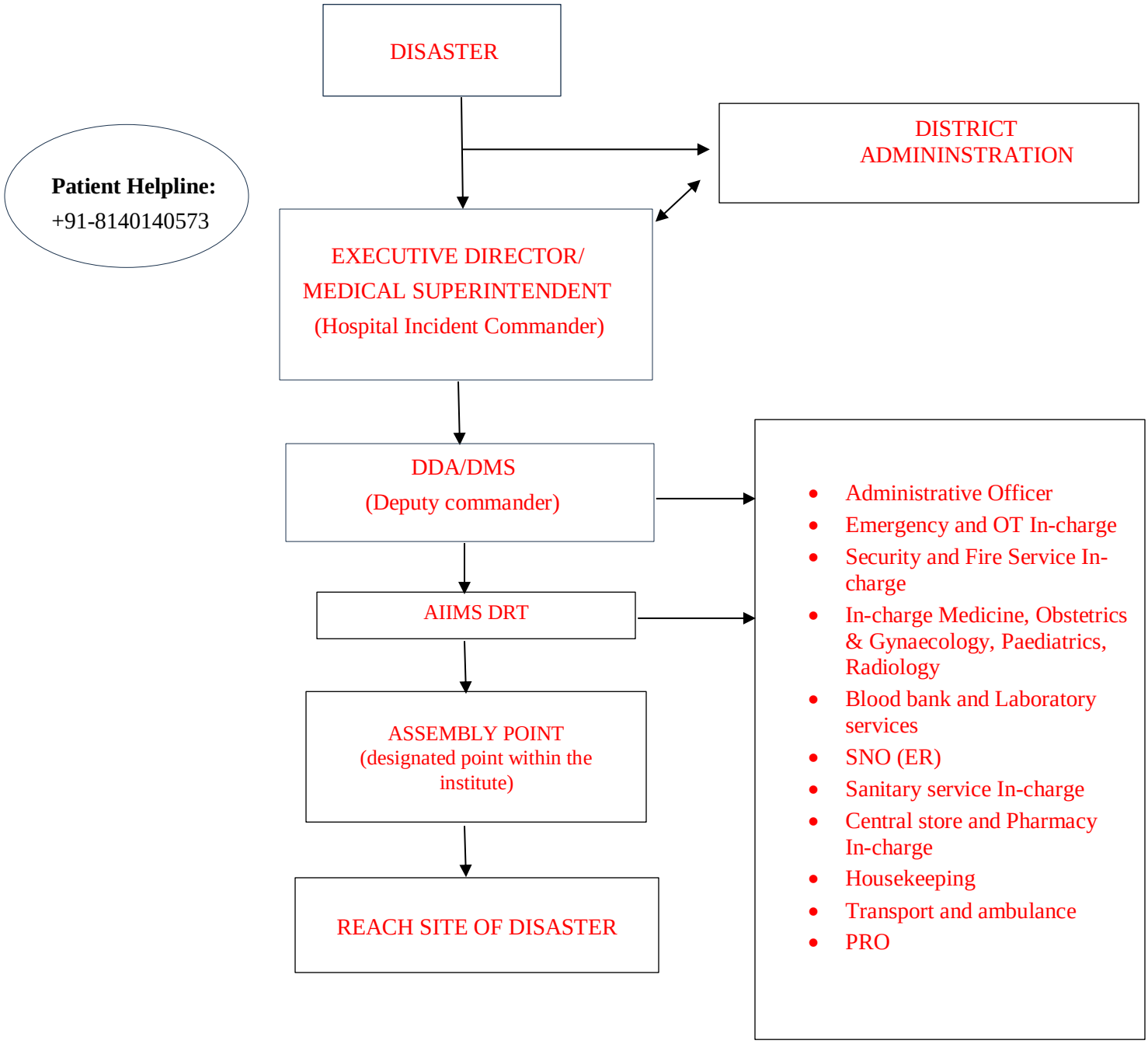
  Stakeholder: Departments of Radiology and Radiation therapy
- Accidents: Buildings in and around the campus shall be regularly inspected and safety standards with regards to civil, mechanical and electrical components checked

  Stakeholder: Executive/Superintending Engineer

ii. *Disaster Risk information improvement and creation of a safe work culture:* All steps taken to ensure adequate surveillance in the campus as well as efforts to increase awareness among students, residents and nursing and ancillary staff. Simple measures such as wearing of helmets while driving two-wheelers, setting speed limits within the campus premises etc. are some of the examples of simple but effective strategies which can be employed.

Stakeholder: Dean (Academics), Faculty (Nursing college), SNOs

3.5.2. Disaster response and HICS-



Flowchart depicting the sequence and chain of directions for the HICS

The HICS is a closely integrated management system which helps both in internal communication and external linkage in an organized manner during times of any natural/man-made emergency. It is:

- A reliable command and control structure
- Helps prioritization of duties
- Has a clear-cut mandate
- Defines roles and responsibilities
- Helps in training and educating hospital staff
- Documents all activities undertaken

As part of the HICS, the following areas have been identified as nodal centers for coordination:

- Director's Office
- MS Office
- DDA Office
- Administrative Officer Office
- ER

The MS office will also serve as the Emergency Operations Center during times of crisis and disaster

3.6. Roles and responsibilities-

i. ER:

- *Triage team***:** This team shall comprise of faculty/residents from Surgery, Orthopaedics, Anaesthesia and Medicine along with nursing and paramedical staff posted in the ER. Their role will be to perform rapid assessment and triage patients into the respective color-coded area.

- *HOD/In-charge Clinical departments:* To ensure that members from their respective departments are available. Additional role will be to ensure adequate supervision as well as guidance of resident doctors so as to enable quick treatment and disposition of patients.

- *HOD/In-charge Anaesthesia:* To designate the department's manpower (faculty and residents) to cover all emergency operating rooms to ensure timely surgical intervention and effective disposal of cases

- *HOD/In-charge Radiology:* To depute adequate residents/faculty as well as technicians to allow for smooth functioning of the ER radiology units such as X-ray, USG, FAST, CT etc.

- *HOD/In-charge Blood bank:* To ensure adequate stock maintenance and availability of essential blood products, including their dispensation.

- *HOD/In-charge Forensic Medicine and CMO:* To ensure proper documentation of all medico-legal cases as well as for liaisoning with police and other law-enforcement agencies.

- *HOD/In-charge Lab services:* To ensure adequate departmental personnel are available to cater to the increased volume of laboratory investigations during times of disaster and emergency.

- *SNO(ER):*

  (a) To ensure all essential drugs are stocked and available in the ER. Expired drugs as well as drugs nearing expiry should be sent back to the pharmacy and timely replacement sought.
  (b) To ensure all live saving equipment such as ventilators, defibrillators, laryngoscopes etc., including batteries, are working optimally
  (c) To ensure adequate linen, mattresses and patient gowns are available.
  (d) To designate nursing and paramedical staff to the respective triage areas.
  (e) To ensure adequate manpower availability to enable smooth and hassle-free shifting of patients to wards/ ICU or operating theatres

ii. DMS/Hospital Administration:

- To ensure availibity of the required logistics in terms of manpower, disposables, drugs etc.
- To coordinate the activities on ground between various departments as well as local/district administration so as to ensure optimal utilization of resources and effective patient management.
- To brief the PRO of the institute, as per directions from the Executive Director.

iii. In-charge Security and Fire services: To arrange for enough manpower for crowd control and ensure safety and security of all hospital staff.

iv. In-charge Central store, Pharmacy and CSSD: To ensure availibity of all essential hospital items, including drugs, and to coordinate their services. CSSD to be equipped with the necessary manpower to enable a faster turn around time for all essential instruments and equipment.

4. INITIAL ASSESSMENT AND MANAGEMENT

4.1. Introduction -

When treating injured patients, clinicians rapidly assess injuries and institute life-preserving therapy. Because timing is crucial, a systematic approach that can berapidly and accurately applied is essential. This approach, termed the "initial assessment," includes the following elements:

- Preparation
- Triage
- Primary survey (ABCDEs) with immediate resuscitation of patients withlife-threatening injuries
- Adjuncts to the primary survey and resuscitation
- Consideration of the need for patient transfer
- Secondary survey (head-to-toe evaluation and patient history)
- Adjuncts to the secondary survey
- Continued post - resuscitation monitoring and reevaluation
- Definitive care

The primary and secondary surveys are repeated frequently to identify any change in the patient's status that indicates the need for additional intervention. The assessment sequence presented in this chapter reflects a linear, or longitudinal, progression of events. In an actual clinical situation, however, manyof these activities occur simultaneously. The longitudinal progression of the assessment process allows clinicians an opportunity to mentally review the progress of actual trauma resuscitation.

4.2. Preparation –

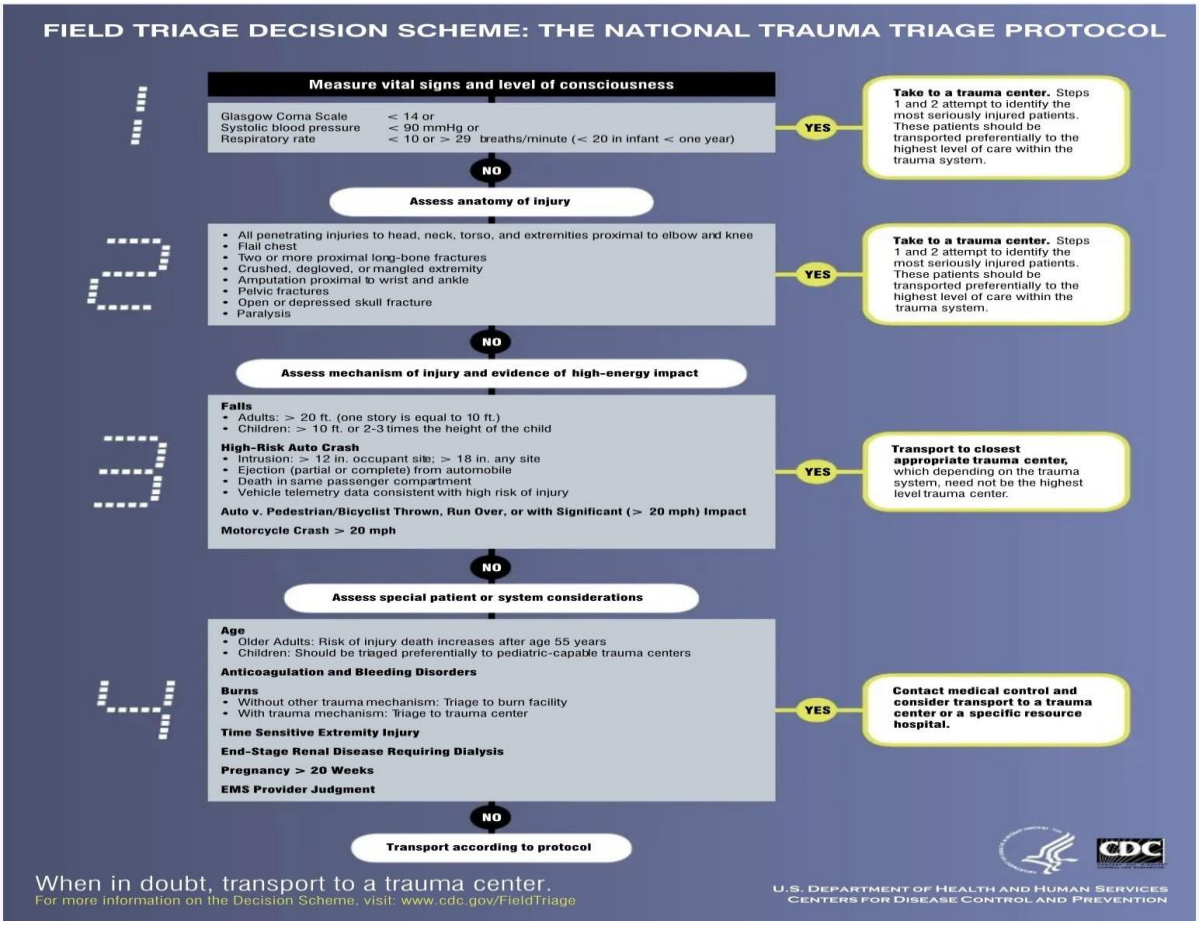
Preparation for trauma patients occurs in two different clinical settings: in the field and in the hospital. First, during the prehospital phase, events are coordinated with the clinicians at the receiving hospital.

Second, during the hospital phase, preparations are made to facilitate rapid trauma patient resuscitation.

(a) Pre-Hospital Phase -

Coordination with prehospital agencies and personnel can greatly expedite treatment in the field
The prehospital system ideally is set up to notify the receiving hospital before personnel transport the patient from the scene. This allows for mobilization of thehospital's trauma team members so that all necessary personnel and resources are present in the ED at the time of the patient's arrival.
During the prehospital phase, providers emphasize airway maintenance, controlof external bleeding and shock, immobilization of the patient, and immediate transport to the closest appropriate facility, preferably a verified trauma center.

Prehospital providers must make every effort to minimize scene time, conceptsthat are supported by the Field Triage Decision Scheme, shown in below table.



(b) Hospital phase -

Advance planning for the arrival of trauma patients is essential. The hand-over between prehospital providers and those at the receiving hospital should be a smooth process, directed by the trauma team leader, ensuring that all important information is available to the entire team. Critical aspects of hospital preparation include the following:

• A resuscitation area is available for trauma patients.
• Properly functioning airway equipment (e.g., laryngoscope and endotracheal tubes) is organized, tested, and strategically placed to be easily accessible.
• Warmed intravenous crystalloid solutions are immediately available for infusion, as are appropriate monitoring devices.
• A protocol to summon additional medical assistance is in place, as well as a means to ensure prompt responses by laboratory and radiology personnel.
• Transfer agreements with verified trauma centers are established and operational.

Due to concerns about communicable diseases, particularly hepatitis and AIDS, the CDC and other health agencies strongly recommend the use of standard precautions (e.g., face mask, eye protection, water-impervious gown, and gloves) when coming into contact with body fluids

4.3. Triage –

Triage involves the sorting of patients based on the resources required for treatment and the resources that are actually available. The order of treatment is based on the ABC priorities.

Red	First priority	Most urgent	**Life-threatening shock or hypoxia is present or imminent, but the patient can likely be stabilized and, if given immediate care, will probably survive**
Yellow	Second priority	Urgent	The injuries have systemic implications or effects, but patients are not yet in life-threatening shock or hypoxia; although systemic decline may ensue, given appropriate care, can likely withstand a 45- to 60-min wait without immediate risk
Green	Third priority	Non-urgent	Injuries are localized without immediate systemic implications; with a minimum of care, these patients generally are unlikely to deteriorate for several hours, if at all
Black		Dead	No distinction can be made between clinical and biologic death in a mass casualty incident, and any unresponsive patient who has no spontaneous ventilation or circulation is classified as dead. Some place catastrophically injured patients who have a slim chance for survival regardless of care in this triage category

Triage is most useful when dealing with situations such as multiple casualties or mass casualties.

(a) Multiple casualties -
Multiple-casualty incidents are those in which the number of patients and the severity of their injuries do not exceed the capability of the facility to render care.In such cases, patients with life-threatening problems and those sustaining multiple-system injuries are treated first.

(b) Mass Casualties -
In mass-casualty events, the number of patients and the severity of their injuries does exceed the capability of the facility and staff. In such cases, patients having the greatest chance of survival and requiring the least expenditure of time, equipment, supplies, and personnel are treated first.

4.4. Primary Survey with Simultaneous Resuscitation –

Patients are assessed, and their treatment priorities are established, based on their injuries, vital signs, and the injury mechanisms. Logical and sequential treatment priorities are established based on the overall assessment of the patient. The patient's vital functions must beassessed quickly and efficiently. Management consists of a rapid primary survey with simultaneous resuscitation of vital functions, a more

detailed secondary survey, and the initiation of definitive care.
The primary survey encompasses the ABCDEs of trauma care and identifies life-threatening conditions by adhering to this sequence:

1. Airway maintenance with restriction of cervical spine motion
2. Breathing and ventilation
3. Circulation with hemorrhage control
4. Disability (assessment of neurologic status)
5. Exposure/Environmental control

Clinicians can quickly assess A, B, C, and D in a trauma patient (10-second assessment) by identifying themselves, asking the patient for his or her name, and asking what happened. An appropriate response suggests that there is no major airway compromise (i.e., ability to speak clearly), breathing is not severely compromised (i.e., ability to generate air movement to permit speech), and the level of consciousness is not markedly decreased (i.e., alert enough to describe what happened). Failure to respond to these questions suggests abnormalities in A, B, C, or D that warrant urgent assessment and management.

During the primary survey, life-threatening conditions are identified and treated in a prioritized sequence based on the effects of injuries on the patient's physiology, because at first it may not be possible to identify specific anatomic injuries. For example, airway compromise can occur secondary to head trauma, injuries causing shock, or direct physical trauma to the airway. Regardless of the injury causing airway compromise, the first priority is airway management: clearing the airway, suctioning, administering oxygen, and opening and securing the airway. Because the prioritized sequence is based on the degree of life threat, the abnormality posing the greatest threat to life is addressed first.

(a) Airway Maintenance with Restriction of Cervical SpineMotion -

If the patient is able to communicate verbally, the airway is not likely to be in immediate jeopardy; however, repeated assessment of airway patency is prudent. In addition, patients with severe head injuries who have an altered level of consciousness or a GCS score of 8 or lower usually require the placement of a definitive airway (i.e., cuffed, secured tube in the trachea). Initially, the jaw-thrust or chin-lift maneuver often suffices as an initial intervention. If the patient is unconscious and has no gag reflex, the placement of an oropharyngeal airway can be helpful temporarily. Establish a definitive airway if there is any doubt about the patient's ability to maintain airway integrity.

While assessing and managing a patient's airway, take great care to prevent excessive movement of the cervical spine. Based on the mechanism of trauma, assume that a spinal injury exists. Neurologic exam-intubation alone does not exclude a diagnosis of cervical spine injury.

The spine must be protected from excessive mobility to prevent development of or progression of a deficit. The cervical spine is protected with a cervical collar. When airway management is necessary, the cervical collar is opened, and a team member manually restricts motion of the cervical spine.

(b) Breathing and Ventilation -

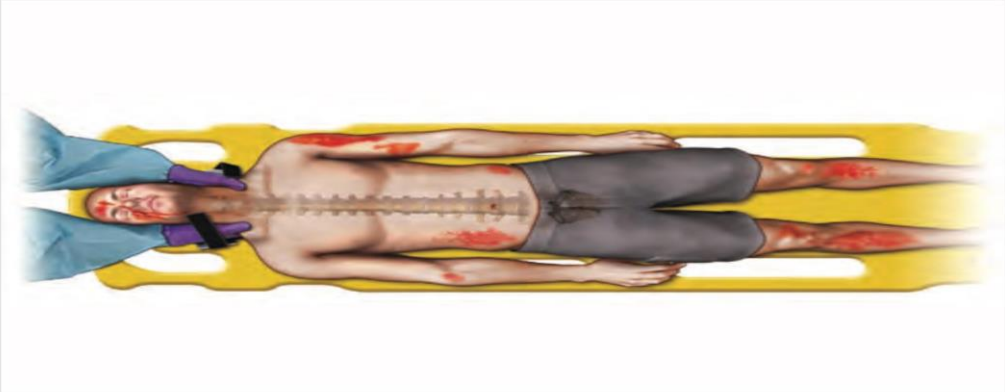


FIGURE 1-4 Cervical spine motion restriction technique. When the cervical collar is removed, a member of the trauma team manually stabilizes the patient's head and neck.

Airway patency alone does not ensure adequate ventilation. Adequate gas exchange is required to maximize oxygenation and carbon dioxide elimination. Ventilation requires adequate function of the lungs, chest wall, and diaphragm; therefore, clinicians must rapidly examine and evaluateeach component.

To adequately assess jugular venous distention, position of the trachea, and chest wall excursion, expose the patient's neck and chest. Perform auscultation to ensure gas flow in thelungs. Visual inspection and palpation can detect injuries to the chest wall that may be compromising ventilation. Percussion of the thorax can also identify abnormalities, but during a noisy resuscitation this evaluation may be inaccurate.

Injuries that significantly impair ventilation in the short term include tension pneumothorax, massive hemothorax, open pneumothorax, and tracheal or
bronchial injuries. These injuries should be identified during the primary survey and often require immediate attention to ensure effective ventilation. Because a tension pneumothorax compromises ventilation and circulation dramatically and acutely, chest decompression should follow immediately when suspected by clinical evaluation.

Every injured patient should receive supplemental oxygen. If the patient is not intubated, oxygen should be delivered by a mask-reservoir device to achieve optimal oxygenation. Use a pulse oximeter to monitor adequacy of hemoglobin oxygen saturation. Simple pneumothorax, simple hemothorax, fractured ribs, flail chest, and pulmonary contusion can compromise ventilation to a lesser degree and are usually identified during the secondary survey. A simple pneumothorax can be converted to a tension pneumothorax when a patient is intubated and positive pressure ventilation is provided before decompressing the pneumothorax with a chest tube.

(c) Circulation with Hemorrhage Control -

Circulatory compromise in trauma patients can result from a variety of injuries. Blood volume, cardiac

output, and bleeding are major circulatory issues to consider.

Blood Volume and Cardiac Output -

Hemorrhage is the predominant cause of preventable deaths after injury. Identifying, quickly controlling hemorrhage, and initiating resuscitation are therefore crucial steps in assessing and managing such patients. Once tension pneumothorax has been excluded as a cause of shock, consider that hypotension following injury is due to blood loss until proven otherwise. Rapid and accurate assessment of an injured patient's hemodynamic status is essential. The elements of clinical observation that yield important information within seconds are level of consciousness, skin perfusion, and pulse.

Level of Consciousness—When circulating blood volume is reduced, cerebral perfusion may be critically impaired, resulting in an altered level of consciousness.

Skin Perfusion—This sign can be helpful in evaluating injured hypovolemic patients. A patient with pink skin, especially in the face and extremities, rarely has critical hypovolemia after injury. Conversely, a patient with hypovolemia may have ashen, gray facial skin and pale extremities.

Pulse—A rapid, thready pulse is typically a sign of hypovolemia. Assess a central pulse (e.g., femoral or carotid artery) bilaterally for quality, rate, and regularity. Absent central pulses that cannot be attributed to local factors signify the need for immediate resuscitative action.

Bleeding -

Identify the source of bleeding as external or internal. External hemorrhage is identified and controlled during the primary survey. Rapid, external blood loss is managed by direct manual pressure on the wound. Tourniquets are effective in massive exsanguination from an extremity but carry a risk of ischemic injury to that extremity. Use a tourniquet only when direct pressure is not effective and the patient's life is threatened. Blind clamping can result in damage to nerves and veins.

The major areas of internal hemorrhage are the chest, abdomen, retroperitoneum, pelvis, and long bones. The source of bleeding is usually identified by physical examination and imaging (e.g., chest x-ray, pelvic x-ray, FAST or DPL). Immediate management may include chest decompression, and application of a pelvic stabilizing device and/ or extremity splints. Definitive management may require surgical or interventional radiologic treatment and pelvic and long-bone stabilization. Initiate surgical consultation or transfer procedures early in these patients.

Definitive bleeding control is essential, along with appropriate replacement of intravascular volume. Vascular access must be established; typically, two large-bore peripheral venous catheters are placed to administer fluid, blood, and plasma. Blood samples for baseline hematologic studies are obtained, including a pregnancy test for all females of childbearing age and blood type and cross matching. To assess the presence and degree of shock, blood gasesand/or lactate level are obtained. When peripheral sites cannot be accessed, intraosseous infusion, central venous access, or venous cutdown may be used depending on the patient's injuries and the clinician's skill level.

Aggressive and continued volume resuscitation is not a substitute for definitive control of hemorrhage. Shock associated with injury is most often hypovolemic in origin. In such cases, initiate IV fluid therapy with crystalloids. All IV solutions should be warmed either by storage in a warm environment (i.e., 37°C

to 40°C, or 98.6°F to 104°F) or administered through fluid- warming devices. A bolus of 1 L of an isotonic solution may be required.

(d) Disability (neuralgic evaluation) –

A rapid neurologic evaluation establishes the patient's level of consciousness and pupillary size and reaction; identifies the presence of lateralizing signs; and determines spinal cord injury level, if present. The GCS is a quick, simple, and objective method of determining the level of consciousness. The motor score of the GCS correlates with outcome. A decrease in a patient's level of consciousness may indicate decreased cerebral oxygenation and/or perfusion, or it may be caused by direct cerebral injury. An altered level of consciousness indicates the need to immediately reevaluate the patient's oxygenation, ventilation, and perfusion status.
Hypoglycemia, alcohol, narcotics, and other drugs can also alter a patient's level of consciousness. Until proven otherwise, always presume that changes in level of consciousness are a result of central nervous system injury. Remember that drug or alcohol intoxication can accompany traumatic brain injury. Primary brain injury results from the structural effect of the injury to the brain. Prevention of secondary brain injury by maintaining adequate oxygenation and perfusion are the main goals of initial management. Because evidence of brain injury can be absent or minimal at the timeof initial evaluation, it is crucial to repeat the examination. Patients with evidence of brain injury should be treated at a facility that has the personnel and resources to anticipate and manage the needs of these patients. When resources to care for these patients are not available arrangements for transfer should begin as soon as this condition is recognized. Similarly, consult a neurosurgeon once a brain injury is recognized.

(e) Exposure and environmental control –

During the primary survey, completely undress the patient, usually by cutting off his or her garments to facilitate a thorough examination and assessment. After completing the assessment, cover the patient with warm blankets or an external warming device to prevent him or her from developing hypothermia in the trauma receiving area. Warm intravenous fluids before infusing them, and maintain a warm environment. Hypothermia can be present when the patient arrives, or it may develop quickly in the ED if the patient is uncovered and undergoes rapid administration of room-temperature fluids or refrigerated blood. Because hypothermia is a potentially lethal complication in injured patients, take aggressive measures to prevent the loss of body heat and restore body temperature to normal. The patient's body temperature is a higher priority than the comfort of the healthcare providers, and the temperature of the resuscitation area should be increased to minimize the loss of body heat. The use of a high-flow fluid warmer to heat crystalloid fluids to 39°C (102.2°F) is recommended. When fluid warmers are not available, a microwave can be used to warm crystalloid fluids, but it should never be used to warm blood products.

4.5. Adjuncts used during the primary survey -

1. Electrocardiograph Monitoring
2. Pulse oximetry
3. Ventilatory rate, Capnography
4. ABG
5. Urinary Catheters
6. Gastric Catheters

7. X-ray examinations and diagnostic studies
8. FAST, eFAST, and DPL

4.6. Consider Need for Patient transfer -

During the primary survey with resuscitation, the evaluating doctor frequently obtains sufficient information to determine the need to transfer the patient to another facility for definitive care.
This transfer process may be initiated immediately by administrative personnel at the direction of the trauma team leader while additional evaluation and resuscitative measures are being performed. It is important not to delay transfer to perform an in- depth diagnostic evaluation.
Only undertake testing that enhances the ability to resuscitate, stabilize, and ensure the patient's safe transfer. Once the decision to transfer a patient has been made, communication between the referring and receiving doctors is essential.

4.7. Secondary Survey

The secondary survey does not begin until the primary survey (ABCDE) is completed, resuscitative efforts are under way, and improvement of the patient's vital functions has been demonstrated. When additional personnel are available, part of the secondary survey may be conducted while the other personnel attend to the primary survey. This method must in no way interfere with the performance of the primary survey, which is the highest priority.
The secondary survey is a head-to-toe evaluation of the trauma patient—that is, a complete history and physical examination, including reassessment of all vital signs. Each region of the body is completely examined. The potential for missing an injury or failing to appreciate the significance of an injury is great, especially in an unresponsive or unstable patient.

(a) History

Every complete medical assessment includes a history of the mechanism of injury. Often, such a history cannot be obtained from a patient who has sustained trauma; therefore, prehospital personnel and family must furnish this information. The AMPLE history is a useful mnemonic for this purpose:

- Allergies
- Medications currently used
- Past illnesses/Pregnancy
- Last meal
- Events/Environment related to the injury

The patient's condition is greatly influenced by the mechanism of injury. Knowledge of the mechanism of injury can enhance understanding of the patient's physiologic state and provide clues to anticipated injuries. Some injuries can be predicted based on the direction and amount of energy associated with the mechanism of injury. Injury patterns are also influenced by age groups and activities.
Injuries are divided into two broad categories: blunt and penetrating trauma. Other types of injuries for which historical information is important include thermal injuries and those caused by hazardous environments.

(b) Physical examination

During the secondary survey, physical examination follows the sequence of head, maxillofacial structures, cervical spine and neck, chest, abdomen and pelvis, perineum/rectum/vagina, musculoskeletal system, and neurological system.

Head-
The secondary survey begins with evaluating the head to identify all related neurologic injuries and any other significant injuries. The entire scalp and head should be examined for lacerations, contusions, and evidence of fractures.
Because edema around the eyes can later preclude an in-depth examination, the eyes should be reevaluated for:
• Visual acuity
• Pupillary size
• Hemorrhage of the conjunctiva and/or fundi • Penetrating injury
• Contact lenses (remove before edema occurs) • Dislocation of the lens
• Ocular entrapment
Clinicians can perform a quick visual acuity examination of both eyes by asking the patient to read printed material, such as a handheld Snellen chart or words on a piece of equipment.
Ocular mobility should be evaluated to exclude entrapment of extraocular muscles due to orbital fractures. These procedures frequently identify ocular injuries that are not otherwise apparent.

Maxillofacial Structures-
Examination of the face should include palpation of all bony structures, assessment of occlusion, intraoral examination, and assessment of soft tissues.
Maxillofacial trauma that is not associated with airway obstruction or major bleeding should betreated only after the patient is stabilized and life-threatening injuries have been managed. At the discretion of appropriate specialists, definitive management may be safely delayed without compromising care.
Patients with fractures of the midface may also have a fracture of the cribriform plate. For these patients, gastric intubation should be performed via the oral route.

Cervical Spine and Neck-
Patients with maxillofacial or head trauma should be presumed to have a cervical spine injury (e.g., fracture and/or ligament injury), and cervical spine motion must be restricted. The absence of neurologic deficit does not exclude injury to the cervical spine, and such injury should be presumed until evaluation of the cervical spine is completed. Evaluation may include radiographic series and/or CT, which should be reviewed by a doctor experienced in detecting cervical spine fractures radiographically. Radiographic evaluation can be avoided in patients who meet the NEXUS Criteria or the CCR.

Chest-
Visual evaluation of the chest, both anterior and posterior, can identify conditions such as open pneumothorax and large flail segments. A complete evaluation of the chest wall requires palpation of the

entire chest cage, including the clavicles, ribs, and sternum. Sternal pressure can be painful if the sternum is fractured or costochondral separations exist. Contusions and hematomas of the chest wall will alert the clinician to the possibility of occult injury.

Abdomen and Pelvis-
Abdominal injuries must be identified and treated aggressively. Identifying the specific injury is less important than determining whether operative intervention is required. A normal initial examination of the abdomen does not exclude a significant intra-abdominal injury. Close observation and frequent reevaluation of the abdomen, preferably by the same observer, are important in managing blunt abdominal trauma, because over time, the patient's abdominal findings can change. Early involvement of a surgeon is essential.
Pelvic fractures can be suspected by the identification of ecchymosis over the iliac wings, pubis, labia, or scrotum. Pain on palpation of the pelvic ring is an important finding in alert patients. In addition, assessment of peripheral pulses can identify vascular injuries.

Perineum, Rectum, and Vagina-
The perineum should be examined for contusions, hematomas, lacerations, and urethral bleeding.
A rectal examination may be performed to assess for the presence of blood within the bowel lumen, integrity of the rectal wall, and quality of sphincter tone.
Vaginal examination should be performed in patients who are at risk of vaginal injury. The clinician should assess for the presence of blood in the vaginal vault and vaginal lacerations. In addition, pregnancy tests should be performed on all females of childbearing age.

Neurological System-
A comprehensive neurologic examination includes motor and sensory evaluation of the extremities, as well as reevaluation of the patient's level of consciousness and pupillary size and response. The GCS score facilitates detection of early changes and trends in the patient's neurological status.
Early consultation with a neurosurgeon is required for patients with head injury. Monitor patients frequently for deterioration in level of consciousness and changes in the neurologic examination, as these findings can reflect worsening of an intracranial injury. If a patient with a head injury deteriorates neurologically, reassess oxygenation, the adequacy of ventilation and perfusion of the brain (i.e., the ABCDEs). Intracranial surgical intervention or measures for reducing intracranial pressure may be necessary. The neurosurgeon will decide whether conditions such as epidural and subdural hematomas require evacuation, and whether depressed skull fractures need operative intervention

4.8. Adjuncts to the secondary survey -
Specialized diagnostic tests

1. CT scan
2. Contrast studies
3. Extremity X ray
4. Endoscopy
5. Ultrasonography

4.9. Reevaluation -

Trauma patients must be reevaluated constantly to ensure that new findings are not overlooked and to discover any deterioration in previously noted findings.

4.10. Definitive care -

Whenever the patient's treatment needs exceed the capability of the receiving institution, transfer is considered. This decision requires a detailed assessment of the patient's injuries and knowledge of the capabilities of the institution, including equipment, resources, and personnel. Interhospital transfer guidelines will help determine which patients require the highest level of trauma care.

4.11. Teamwork-

The trauma team typically includes-

1. Team leader
2. Assessing the patient, including airway assessment and management
3. Undressing and exposing the patient
4. Applying monitoring equipment•
5. Obtaining Intravenous Access and drawing blood
6. Serving as scribe or recorder of resuscitation activity

4.12. Records And legal considerations-

Meticulous record keeping is crucial during patient assessment and management, including documenting the times of all events. Often more than one clinician cares for an individual patient, and precise records are essential for subsequent practitioners to evaluate the patient's needs and clinical status. Accurate record keeping during resuscitation can be facilitated by assigning a member of the trauma team the primary responsibility to accurately record and collate all patient care information.
Medicolegal problems arise frequently, and precise records are helpful for all individuals concerned. Chronologic reporting with flow sheets helps the attending and consulting doctors quickly assess changes in the patient's condition.

(a) Consent For treatment

Consent is sought before treatment, if possible. In life-threatening emergencies, it is often not possible to obtain such consent. In these cases, provide treatment first, and obtain formal consent later.

(b) Forensic evidence

If criminal activity is suspected in conjunction with a patient's injury, the personnel caring for the patient must preserve the evidence. All items, such as clothing and bullets, are saved for law enforcement personnel. Laboratory determinations of blood alcohol concentrations and other drugs may be particularly pertinent and have substantial legal implications.
In many centers, trauma patients are assessed by a team.

5. DISASTER MANAGEMENT IN SPECIFIC SCENARIOS

5.1. Blast injuries –

These are multisystem injuries caused by explosions. The inciting factor in such cases is a supersonic overpressure shock wave which produces an air-fluid interface. Thus, most common injuries reported in such cases involve the pulmonary and gastrointestinal systems. In addition to these, explosives are sometimes packed with projectiles which can lead to penetrating injuries.
Mechanism of blast related injuries is as follows:

- Primary blast injury: Result from direct effect of the blast wave and mainly damage gas containing organs such as gastrointestinal tract, lung and middle ear.
- Secondary blast injury: Injuries which result from patients being struck by objects and debris that have been accelerated by explosion e.g. shrapnels, projectiles etc.
- Tertiary blast injury: Result from the victims being thrown by the high wind produced by the blast wave
- Quaternary blast injury: Burn injuries, toxic gas inhalation, poisoning etc.

5.2. Earthquakes/Landslides/Accidents/Building Collapse-

An earthquake is a sudden, rapid shaking of the ground caused by shifting of the rock beneath the Earth's surface. This can not only cause several buildings or bridges to collapse but can also trigger landslides, avalanches as well as flashfloods. The most dreaded outcome of an earthquake is a tsunami. The principles of management are like any other disaster and include the PMRR approach. The same concept will apply to a mass casualty event following a road or railway accident.
Immediate cause of death in such cases include direct trauma to the head, chest, major blood vessels or suffocation under the rubble. Delayed mortality can occur due to sepsis or renal failure following crush syndrome and acute rhabdomyolysis.
Successful extrication of earthquake/landslide/accident/building collapse victims relies a great deal on verbal communication and clues as to the victim's location. Moreover, resuscitation with adequate airway, ventilatory support, fluid boluses and prevention of hypothermia are fundamental measures which have shown to be effective to delaying the onset of AKI and secondary rhabdomyolysis. Fluid resuscitation requires securing immediate IV access and initiation of isotonic crystalloids at the rate of 1-1.5L/hour in adults and 20ml/kg/hour in children. Potassium containing fluid such as RL must be avoided.
In addition to crush injury, another potential complication afflicting upper and lower extremities in these patients is compartment syndrome. Timely intervention by an orthopaedic surgeon can help mitigate any further vascular damage to the limb.

5.3. Chemical Spill-

(a) *Nerve agents*: Disrupt both muscarinic and nicotinic pathways of the cholinergic system of nerve-muscle communication. Symptoms include loss of consciousness, convulsions, apnea and paralysis. E.g. Sarin
(b) *Asphyxiants*: Inhibit body's capacity to perform aerobic metabolism. Symptoms include loss of

consciousness, convulsions, apnea and cardiac arrest. E.g. Hydrogen cyanide.

(c) *Vesicants*: Agents that cause erythema and redness of the skin along with injury to the eyes, airway and organ systems e.g. Sulphur mustard and Lewisite. Symptoms include blurring of vision, upper respiratory distress, conjunctivitis etc.

(d) *Pulmonary agents*: Cause pulmonary edema e.g. phosgene, chlorine.

Exposure to Nerve Agents (Muscarinic System)		Exposure to Nerve Agent Symptoms (Nicotinic System)
SLUDGE*	DUMBELS*	MTW(t)HF^
Salivation,	**D**iarrhea	• **M**ydriasis
Lacrimation	**U**rination	• **T**achycardia
Urination	**M**iosis	• **W**eakness (muscle)
Defecation	**B**radycardia, Bronchorrhea, Bronchospasm	• **(t)H**ypertension, hyperglycemia
Gastroenteritis	**E**mesis	• **F**asciculations
Emesis	**L**acrimation	
	Salivation, Secretions, Sweating	^ Nicotinic effects

* Muscarinic effects treated with atropine

Symptomatic presentation of nerve agents

Nerve Agents
- Ventilation with oxygen
- Suction of copious secretions from airways
- Atropine (antidote)—affects muscarinic system symptoms
- Pralidoxime (2-PAM) (antidote)—affects nicotinic system symptoms. Timing of 2-PAM administration is critical because the binding of the nerve agents to cholinesterase (enzyme responsible for breaking down the neurotransmitter acetylcholine) can become irreversible with time.
- Diazepam—auto-injector for convulsions
- DuoDote—single auto injector (atropine+ pralidoxime)
- Mark I Kit—atropine + pralidoxime chloride auto-injectors

Asphyxiant Agents
- Ventilation with oxygen
- Cyanide antidote kit or hydroxocobalamin IV (preferred)

Pulmonary Agents
- Termination of exposure
- Oxygen/ventilation as needed
- No physical activity!

Vesicant Agents
- Decontamination
- Symptomatic management of lesions

Riot Control Agents (tear gasses/lacrimators)
- Generally not life-threatening
- Symptomatic management of lesions
- Normal saline irrigation to eyes or cool water and liquid skin detergent to affected areas of body.
- CN (Chloroacetophenone) and CS (chlorobenzyliden malononitrile) most common.

Management of chemical spills and injuries

5.4. Radiation exposure-

Broadly speaking, radiation effects can be categorized into Stochastic and Non-stochastic (deterministic) effects. While for the former, the extent and severity of the effect increases with the dose without any threshold, deterministic effects are characterized by a distinct threshold beyond which only these effects are apparent.

Principles of management of radiation victims include:

- Adherence to the ABCDE principles of trauma and triage.
- Perform decontamination before, during and after initial stabilization, depending upon the extent and severity of injury.
- Understand the limitations of radiation detecting equipment.
- Emergency surgery and wound closure should be performed early in victims of radiation poisoning.
- Symptoms of ARS are as:

- Group of clinical sub-syndromes that develop acutely (within several seconds to several days) after exposure to penetrating ionizing radiation above whole-body doses of I Gy (I00 rads).
- ARS affects different systems, depending on the total dose of radiation received.
- Lower doses predominantly damage the hematopoietic system.
- Increasing doses damage the gastrointestinal system, the cardiovascular system, and the central nervous system, in that order.
- The higher the exposure, the earlier symptoms will appear and the worse the prognosis.

Prodromal Phase

- Symptoms—nausea, vomiting, diarrhea, fatigue

Latent Phase

- Length of phase variable depending on the exposure level
- Symptoms and signs—relatively asymptomatic, fatigue, bone marrow depression
- A reduced lymphocyte count can occur within 48 hours and is a clinical indicator of the radiation severity.

Manifest Illness

- Symptoms—Clinical symptoms associated with major organ system injury (marrow, intestinal, neurovascular)

Death or Recovery

Symptoms of ARS

Nuclear Detonations

Three types of injuries result from nuclear detonations:

- Blast injuries—overpressure waves
- Thermal injuries—flash and flame burns
- Radiation injuries—irradiation by gamma waves and neutrons and radioactive debris (fallout)

Meltdown of a Nuclear Reactor

- Core must overheat, causing nuclear fuel to melt
- Containment failure must occur, releasing radioactive materials into environment

Radiation Dispersal Device (dirty bomb)

- Conventional explosive designed to spread radioactive material
- No nuclear explosion

Simple Radiological Dispersion

- Simple radioactive device that emits radioactivity without an explosion

Radiation threat scenarios

5.5. Floods and tsunamis-

A flood is an overflow of an expanse of water that is able to submerge an area of land. Floods are caused due to heavy monsoons beyond the capacity of the rivers and the drainage system. Tsunamis, on the other hand, are usually seen in the aftermath of a severe earthquake.

Immediate cause of death in most instances is drowning with burn injuries, electrocution and hypothermia accounting for secondary causes of mortality and morbidity. In addition, poor sanitation, lack of hygiene and infectious diseases are serious concerns and can cause an epidemic outbreak in flood afflicted victims

Patient management in these cases is usually on the same lines as anywhere else with a heightened emphasis on epidemic mitigation. A relatively less talked about aspect of patient management in all disaster victims is the adverse impact on mental health and long-term PTSD. Facilities must be made for appropriate patient counselling and a mental health expert must be consulted at all levels to address the same.

5.6. Meteorological disasters (Cyclones/Hurricanes etc.)-

Tropical depressions typically involve an area of low-pressure, with wind speeds exceeding 61km/hour. When the latter sustains a top speed of more than 63 km/hour, it is known as a Tropical storm. These low-pressure systems classically originate over a warm water body and are christened differently depending upon their source of origin – cyclones when they originate over the South Pacific or Indian Ocean, hurricanes when they are seen over the North Atlantic or Pacific and typhoons when they develop over the Northwestern Pacific. These are high energy systems and cause intense damage to life and property when and where they make landfall.

India with its vast coastline and a tropical climate has been prone to several such cyclonic storms over the past many decades. The most common cause of mortality in such conditions is usually trauma secondary to being hit by a flying or a falling object. Other potential causes include crush injury, drowning, electrocution etc.

Patient management requires special emphasis on management of head and spine related injuries (as these are the most commonly injured areas).

5.7. Decontamination & Evacuation-

Decontamination is the removal of hazardous materials from contaminated persons or equipment without further contaminating the patient and the environment, including hospitals and rescuers. Decontamination may be necessary following both natural and human-made disasters.

Prehospital and hospital personnel must rapidly determine the likelihood of contaminated victims and decontamination must be performed before patients enter the emergency department. Failure to do so can result in contamination and subsequent quarantine of the entire facility. Hospital security and local police may be required to lockdown a facility to prevent contaminated patients from entering the hospital.

The basic principles in response to any hazardous material incident are the same regardless of the agents involved.

- Removal of clothing and jewelry may reduce contamination by up to 85%, especially with biological and radioactive agents.
- medical providers must wear the appropriate level of personal protective equipment to protect themselves.
- The site for decontamination is arranged in three zones: the hot zone, the warm zone, and the cold zone.

    - The hot zone is the area of contamination. The area should be isolated immediately to avoid further contamination and casualties.
    - The warm zone is the area where decontamination takes place. The warm zone should be "upwind" and "uphill" from the hot zone. IM antidotes and simple life- saving medical procedures, such as controlling hemorrhage, can be administered to patients before

      decontamination by medical personnel wearing appropriate protective gear.
    - The cold zone is the area where the decontaminated patient is taken for definitive care, if needed, and disposition (transfer to other facilities or discharge)

There are two types of decontamination:

1. Gross decontamination
2. Full decontamination

The choice of decontamination technique depends on the number of casualties, severity of contamination, severity of injuries, and available resources.

- Gross decontamination consists of removing the patient's clothing and jewelry and, if possible, irrigating the patient's entire body with water. Casualties may be rinsed off with water hoses and sprays. This type of decontamination is often used in mass-casualty events.

- Full decontamination (ambulatory or non-ambulatory) is more time-consuming and expensive. Many hospitals use portable decontamination tents for this purpose.

DISASTER AND TRAUMA

Evacuation is often necessary in disasters at the disaster scene as well as to facilitate transfer of patients to other hospitals. Acute care providers must be aware of physiological changes that can occur during air evacuation due to the hypobaric environment and decreased partial pressure of oxygen.

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