Please share your comments/suggestions on this task force separately on an individual page by 20th June 2024 on email Id: umeshkapil@gmail.com.

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DRAFT

NATIONAL ACADEMY OF MEDICAL SCIENCES (INDIA)

ARMED FORCES MEDICAL SERVICES (INDIA)

DIRECTORATE GENERAL OF HEALTH SERVICES

MINISTRY OF HEALTH & FAMILY WELFARE
GOVERNMENT OF INDIA

REPORT OF TASK FORCE

ON

GUN-SHOT AND BLAST INJURIES

2024

NAMS – DGAFMS – DGHS – Govt. of India – Task Force Series No. 11

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&

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ACKNOWLEDGMENT

1. The contributions from all domain experts in the field of trauma, surgery, medicine and forensic medicine, and the members of the Armed Forces of India are acknowledged.

2. The support given by the National Academy of Medical Sciences of India is also acknowledged.

3. This document has been made possible due to the collective effort of all stakeholders and hard work for the last three months. I am sure this document will go a long way to enhance the capabilities of our nation in the field of management of Gun-Shot injuries and Blast Injuries.

-Sd-

Air Vice Marshal
Tanmoy Roy VSM
Chairman, NAMS-AFMS Joint Task Force

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LIST OF ABBREVIATIONS

ACoTS	Acute Coagulopathy of Trauma Shock
AFMS	Armed Forces Medical Services
ANFO	Ammonium Nitrate Fuel Oil
AI	Artificial Intelligence
ATCN	Advanced Trauma Courses for Nurses
ATLS	Advanced Trauma Life Support
AVPU	Alert Verbal Pain Unresponsive
BFNA	Battle Field Nursing Assistant
BI	Blast Injury
BLS	Basic Life Support
BPJ	Battle Protection Jacket
BPL	Below t h e poverty line
BTLS	Basic Trauma Life Support
CAT	Combat Application Tourniquet
CCATT	Critical Care Air Transfer Team
CGHS	Central Government Heath Service
CME	Continuous Medical Education
CPK	Creatinine Phospho Kinase
CPR	Cardiopulmonary Resuscitation
CTLS	Combat Trauma Life Support
CT Scan	Computerisesd Tomography Scan
CUF	Care under Fire
DCR	Damage Control Resuscitation
DCS	Damage control Surgery
DES	Dextra Ethyl Starch
DOW	Died of Wound
DPA	Diagnostic Peritoneal Aspiration
E- FAST	Extended Focused Assessment with Sonography in Trauma
EFONA	Emergency Front of Neck Access
ETC	Early Total Care
ETT	Endo-tracheal Tube
FAST	Focused Assessment with Sonography in Trauma
FDL	Forward Defended Locality
FEBA	Forward Edge of Battle Area
FYP	Five Year Plan
GSW	Gun Shot Wound
HCA	Hypothermia Coagulopathy Acidosis (triad/ syndrome)
HBV	Hepatitis B Virus
HCV	Hepatitis C Virus
HIV	Human Immunodeficiency Virus
IED	Improvised Explosive Device
IFAK	Individual First Aid Kit
IVUS	Intra Vascular Ultrasound
IO	Intra Osseous
IV	Intra Venous
IVC	Inferior Vena cava
KIA	Killed in Action

LoIE	Low Impact Explosion
LGT	Liver Function Test
MARCHE	Massive Haemorrhage Airway Resuscitation Circulation Haemorrhage and Head Injury Everything Else
MeSH	Medical Subjects and Headings
MESS	Mangled Extremity Severity Score
MI	Myocardial Infraction
MODA	Management of Difficult Airway
MoHFW	Ministry of Health and Family Welfare
MTBI	Mild Traumatic Brain Injury
MTSP	Medical Technology Service Providers
NAMS	National Academy of Medical Sciences
NMC	National Medical Commission
NPA	Nasopharyngeal Airway
NPBW	Non prohibited bore weapons
NPPMT&BI	National Programme for Prevention & Management of Trauma & Burn Injuries
OPA	Oropharyngeal Airway
PBW	Prohibited Bore Weapons
PHC	Primary Health Centre
PTSD	Post Traumatic Stress Disorder
PTU	Patient Transfer Unit
RMS	Railway Medical Service
RAP	Regimental Aid Post
RFT	Renal Function Test
RMO	Regimental Medical Officer
RSI	Rapid Sequence Intubation
RTD	Returned To Duty
SABC	Self Aid Buddy Care
SGA	Supraglottic Airway
TACEVAC	Tactical Evacuation Care
TCCC	Tactical Combat Casualty Care
TFC	Tactical Field Care
TNT	Tri Nitro Toluene
USG	Ultrasonography
VIPD	Violence and Injury Prevention and Disability
WIA	Wounded in Action

PREFACE

1. The National Academy of Medical Sciences (NAMS) and Armed Forces Medical Services (AFMS) have constituted a joint Task force on **Gun-shot & Blast Injuries** and have developed a white paper for submission to the Government of India. This white paper is aimed at improving the interventions in the area of **Gun-shot & Blast Injuries**. MOHFW, New Delhi, which acts as an advisory body to the Government in matters related to National Health Policy & planning as well as Continuing Medical Education (CME) for medical & health professionals, may set up expert committees towards attaining the proposed goals.

2. This document is prepared, focusing on the terms of reference and has made an honest attempt to place the current situation in the country in a broader context. The subject matter is of great importance in view of the increasing violence on account of firearms and explosives which have changed from single shot weapons to automatic guns and remote-controlled explosives which needs to be addressed. This has become more important in view of the rise in transnational crimes and rising incidences of waging war by other means‘ against your adversaries.

3. The document has deliberated upon the current status of the ability to handle firearm and blast injuries in the cities and hinterland of India, the deficiencies in the abilities of the primary, secondary and tertiary medical care set-up limiting provision of comprehensive trauma care, the ambulance services, measures required to competently manage the problem, the need for a national registry and network, and the need for enhanced financial support for trauma care in general and GSW and blast injuries specifically.

4. The changing paradigm in presentation of trauma due to war and terrorism, impact of rapid social changes in an aspirational society, compliance with firearm regulations have been deliberated upon. The importance of learning Basic Life Support, Basic Trauma Life support for the common man and Advanced Trauma Life Support for Nurses, Paramedics and Doctors along the same lines as it exists in the Indian Military has also been stressed upon. A broad discussion of important points in the management of bullet and blast injuries has been included which, although not exhaustive, if adopted by all stakeholders, has the potential of transforming the care of Gunshot Injuries and Blast Injuries in India.

5. It is hoped that this white paper will be given due recognition and adopted while formulating the policies by MoHFW, and other Ministries of the Government of India and the State Governments.

Sd/-
(Tanmoy Roy)
Air Vice Marshal
Chairman, NAMS-AFMS Joint Task Force

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INTRODUCTION

War, conflict, crime and accidents have been omnipresent since the origin of humankind. All diseases may be conquered, but conflict, trauma and war will remain. This is because neither the desire for dominance, supremacy and control over resources will ever end, nor the unexpected‘ will ever stop happening. However, the intense nature and severity of injuries due to GSW, missiles and explosives is progressively on the rise on account of the easy availability of firearms, dramatic shift in the nature of warfare, changes in societal behavior as well as the demographic changes occurring in the world. Incidences of wounding, mutilations and disruption of body parts on account of GSW, missile and blast injuries are increasing progressively all over the world and India cannot remain untouched. Hence, the time has come to address the issue in a substantive manner before it is too late.

BACKGROUND

1. The use of higher order, explosives and indigenous ways of weapon delivery has resulted in unusual and unconventional forms of injuries both in military and civil life. Hence, India needs a comprehensive policy to address the complex issues related to firearms injuries and those due to explosions. This is so that the military / paramilitary/ police and other members of the security establishments as well as the civilian population caught in the crime scene/in crossfire, who are usually unintended victims of collateral damage, are managed comprehensively, and also medical, legal and criminal dimensions of the issue addressed.

2. The more common wounding agents in modern warfare are artillery, missiles and bombs and not GSW, whereas in terrorist operations it is the GSW injuries that predominate. In suicide attacks, it is an improvised explosive device which is the most commonly used agent. Hence the pre-hospital care for the victims needs to be standardized and incorporated as part of medical/ paramedical/ nursing courses universally in the country.

3. The echelons of care, the objectives and standard of initial care, measures to minimize blood loss and maintain oxygenation, the concept of primary survey, secondary survey and triage; followed by treatment, standard of documentation, in maintaining clarity, brevity and consistency with a uniform protocol, needs to be implemented all over the country. If everybody can speak and interpret all relevant matters and communicate amongst the stakeholders along the same lines, it will eliminating communication gap to a large extent. Similarly, the medico- legal aspect relevant to the problem has been addressed in the white paper holistically. This white paper will lead to a comprehensive understanding of the problem from the point of view of policy formulation and its implementation in India.

TERMS OF REFERENCE

1. To identify the current status of Gun-shot & Blast Injuries.

2. Identify the deficiencies which need to be addressed.

3. To recommend measures for management of Gun-shot & Blast Injuries.

METHODOLOGY ADOPTED

The study was commissioned as a joint study by NAMS and the Armed Forces. The study findings are based on an extensive review of literature which was done using the data bases of PuB Med, Cochrane Library, Google Scholar, various books, journals and publications as well as inputs from the manuals used by the Armed Forces. The fields chosen were title, keywords, abstracts and MeSH (Medial Subject Headings). This was followed by extensive discussion and deliberations by team members and the various experts on the subject matter both in person as well as in electronic mode. Extensive inputs based on the experiences of various domain experts were used in critical analysis of the matter. The content and context were analysed in as much detail as possible and inferences obtained relevant to the current

Indian scenario and its projection in the next 10 years by which time India is expected to become a recognized world power.

DETAILED STUDY OF THE SUBJECT MATTER

The matter is discussed under the following lines

1. What is the realistic achievement in matters related to the management of Gun Shot and Blast injuries, that we should aim for the citizens of India, in the next 10 years?

2. What is the current reality in terms of our ability to manage Gun- shot and Blast injuries in India as a country and how to address the gap in capabilities?

3. What measures are necessary for management of Gun-shot & Blast Injuries?

DESIRABLE OBJECTIVES FOR THE NEXT TEN YEARS

1. In the next 10 years, India as a whole should be able to become a country where citizens in any part of India should be able to avail facilities of high quality trauma care, including care of bullet injuries and explosive induced blast injuries. The aim is to save maximum number of lives, reduce disability amongst our countrymen, and proper rehabilitation of victims, so that they can continue to remain productive members of the society and contribute to national economy. This if achieved will become a symbol of the largest social security cover in the world where no family will go on to face poverty due to loss of its bread earner.

2. To achieve this, all citizens must have sufficient knowledge about the actions to be taken to avoid injuries, reduce its impact on occurrence by taking simple measures, get access to immediate emergency care, and get the benefit of universal coverage.

To enable this to happen, the following should be aimed for

(a) All citizens must be equipped with two specific abilities i.e., how to stop bleeding, and how to give cardiopulmonary resuscitation at the point of injury.

(b) Ambulances with medics / paramedics should be able to reach the injured within the golden hour by the fastest means. Alternately, the victim also should be able to reach the nearest trauma care facilities preferably once his / her bleeding and breathing is controlled by the emergency caregiver using the fastest means.

(c) Once the victim reaches the hospital, he should be attended to immediately without any reservation (without financial or legal hurdles) by the attending doctor and his/her team. The hospitals should be protected from financial burden by provision of prompt reimbursement for the treatment provided.

(d) The abilities of the medical fraternity as well as common citizens to manage GSW and blast injuries must be raised by a collective national effort in a planned but time-bound manner at all levels.

(e) The national trauma registry and archiving system as well as all details in respect of gunshot and blast injuries available with the hospital, mortuary, forensic labs, cremation ground, cemeteries, police etc should be digitized, networked and AI enabled to generate a realistic database so that one can look for patterns and improve outcomes by suggesting action points.

(f) The financial support to all hospitals should be given based on a computer based, server-secured and AI enabled network and from a deliberately and consciously developed National corpus from preferably the consolidated fund of India. It is suggested that all transactions in digital format in the country be charged @ 0.01 % as ¯trauma care cess , from which the reimbursement to all the echelons giving robust trauma care is given quickly. Absence of financial support to the hospital, most of which are in a private set-up combined with the inability of the unknown‘ victim to be in a position to pay, till one of his family members could commit on the expected expenditure, is the universal impediment to good trauma care in India and this truth needs to be accepted as we move on as an emerging nation. This needs to change in favour of honest taxpaying citizens who should be automatically insured for treatment as well as BPL families who should be covered under the Ayushman Bharat scheme.

THE CURRENT STATUS OF GUN-SHOT & BLAST INJURIES WITH ACTIONS WHICH ARE REQUIRED TO BE TAKEN

CURRENT SITUATION IN THE COUNTRY

1. Gunshot wounds and blast injuries are steadily developing into a major public health problem in India and seem to be following the trends seen in western nation. This is consistent with the increasing prevalence of firearms and explosives (industrial as well as illegal) in both villages the cities of India [1,2].

2. The exact incidence of Gun-shot injuries in India cannot be ascertained due to lack of reliable data, with only a few reliable studies being available from Armed Forces and civil stream in India which provide some insight into the nature of injuries and outcome [2].

3. A study from Mumbai reflecting an urban setting found that the injured victim was rescued by a passerby in 43.5% of cases and helped by the police in 89.7% instances, with the victim in most cases being transported by a taxi or a private car to a hospital without provision of any emergency medical aid on the site of injury. The ambulance was put to use only in 39.3% of cases. This constitutes a very significant limitation in successful primary management of firearm injuries [3].

EFFECTIVENESS OF AMBULANCE SERVICES

4. The Emergency Medical Service (EMS) in rural India is rudimentary in spite of significant leaps in this field in large metros and capital cities, with the second-tier cities fast catching up with the gradual development of robust emergency ambulance services. However, the ambulance services usually take patients to a hospital based on the likely affordability of the patient based on first impression. In other words, a trauma victim with doubtful financial viability is usually directly taken by Ambulance services to the

Accident & Emergency of a nearby tertiary care multi- superspeciality hospital (most are private entities) only when his life is under imminent threat, when he usually gets attended with the immediate interventions required to save his life. However, once he is identified to constitute a financial burden, the victim is often transferred out to one of the second rung nursing homes on the first available opportunity, usually to the detriment of his safety and health. The government needs to come out with a clear policy on financial compensation for all trauma victims. This is because this group constitutes the largest share of preventable deaths, all over the world and occurs usually in a young earning population out on the road for work or leisure, and contribute to the nation‘s economy. Unless this issue is addressed, victims of salvageable critical Gun-Shot injuries in civilian life will by and large continue to become disabled or lose life.

5. Most state governments and municipalities in the last 10 years have made substantial progress in developing their Ambulance services e.g., 108 Ambulance‘ which are integrated with call centres and work 24 x 7 x 365 days, and this service is slowly progressing towards even tier 2 towns, which is very encouraging. However, we have a long way to go as a nation to make these ambulances capable of handling Blast and Gun-shot injuries. As of now, these ambulances can only give oxygen and fluids and although they have facilities to give CPR, they are not fully geared up to treat GSW / blast injuries. Thus, lack of optimal Ambulance / Transport Services constitute an important limitation in handling GSW / blast injuries and the matter is deliberated below.

6. **Gaps in Ambulance Services** in India is a hurdle which needs an urgent solution. Ambulance Services are managed by a multitude of organizations, including government, and are supported and facilitated by police, fire brigades, hospitals, and private agencies. The controlling agencies and telephone numbers vary from state to state. This needs to become unitary, which is learnt and memorized by children from primary school level across the country. GSW/ BI require specialized care when being evacuated. However, in a study, only 30 ambulances out of 94 could partially cater for the provision of Advanced Trauma Life Support. Another important component in care of these sick patients is a protocol- based on treatment but only 20% district hospitals were found to have a documented emergency manual, with only 8% district hospitals having documented policies and procedures for patient transfer [4].

7. **Staffing of Ambulance**: Majority of the privately managed ambulances lack adequately trained manpower. Many are contractual staff on short stop gap contracts which is due to an absence of any clear regulation regarding minimum qualification/ experience required to man an ambulance as well as absence of regulations on the minimum number of professionals required for manning an ambulance service (medics/ paramedics/telephone attendant/on call roster etc). In the suburbs and hinterland, the situation is even more acute.

8. **Lack of adequate equipment in Ambulances:** Most ambulances are inadequately equipped and are ineffective in providing life-saving trauma care interventions during transport. The impression that stretcher, oxygen, saline, and bandage are enough to run an ambulance service needs to be dispelled.

9. **Misuse of Ambulances:** Misuse of ambulances has been reported by many studies. Another glaring fact is that a large majority of ambulances have been found to transport

the dead sometimes or other either due to an absence of hearse van or due to organizational pressure, thus making them not available for a medical emergency should a situation arise. This should be made a punishable offence.

10. **Lack of coordination between the ambulance services and nearby health facility:** The impending arrival of patients transported to the nearest health facility is usually not communicated in advance to the receiver due to inadequate communication system as well as lack of knowledge amongst bystanders regarding where to take the victim. Private ambulances constitute the majority share. Air ambulances are operational only in certain large cities but affordability is a big drawback. Hovercraft as ambulances in coastal areas is still in its infancy in India, but is expected to be leveraged widely in the next decade. Transfer of patients by helicopter is picking up in difficult terrain and that by drone is on the anvil as the load carrying capacities of indigenous drones are now more than 80 kg. Hence, drones as a viable means of patient transfer, especially of injuries by bullet / explosives, is likely to see the light of the day as a mainstay in the next 5 years.

PRIMARY CARE

11. **Role of primary care physician:** Ideally, primary care physician should become the sheet anchor in initiating the management of firearm induced body disruption and massive blood loss once the first responder has brought the victim to the primary care facility, since the fate of the victim is generally decided in the next 30-60 minutes. However, in India, the ability of a primary care physician to independently impart trauma care is often suboptimal, primarily due to inadequate attention given to training on aspects of trauma care during MBBS and rotating internship training, due to which, although the doctor is reasonably equipped with the theoretical knowledge, he is unable to put the knowledge into practice [8-10]. This serious limitation in skill level must be addressed by mandatory exposure to lifesaving measures in the ATLS trauma certification programme as part of internship training prior to being granted a MBBS degree by the university or being registered for medical practice in the country by the National Medical Council (RMP status) and revalidation of presence of this basic ability every 5 years.

12. **Role of Paramedics:** A competent paramedic helping a casualty doctor meaningfully makes the job of a doctor so much easier. However, in India, paramedics are imparted a very basic knowledge of trauma care, but practically have no experience of it. This is a paradox, since they usually are the first responders. However, they learn many aspects of it if they start working in a field related to trauma / emergency care, which is not common. Since paramedics are now attaining specialization directly after leaving school e.g., in pharmacy, X ray, health, recordkeeping, skin diseases, psychiatry nursing etc directly without at any stage working in an emergency or in a patient ward, they do not learn to handle a sick patient in a ward at all. Hence, the availability of paramedics who could handle the basic emergency requirements of bullet injury has dwindled further. Hence, training in Basic Life support and Basic Trauma Life support courses should be made mandatory as part of the degree and diploma for nurses and paramedics.

13. **Role of Common man:** Common man is by and large unaware of the basics of trauma management and usually is not in a position to help his fellow citizens who have sustained GSW and blast injuries and are in distress. This is unfortunately aggravated by

a sense of apathy more visible in roadside injuries, especially roadside crimes, since victims are unknown, and fear of the consequences of getting involved‘ overwhelms the sense of reason and brotherhood. The citizens have to be taught through various awareness programmes to be more responsible for their helpless brothers and sisters in distress, and any disregard of reasonable help should be made punishable and implemented by withdrawal of social benefits. The social scientists, anthropologists, and NGOs need to help the government in this effort in a very substantive way so that citizens become more responsible. The current approach taken by society, medical fraternity and the Government towards the problem of treating GSW and Explosive induced blast injuries needs to change.

PARTS OF THE BODY DISRUPTED IN A BLAST INJURY

14. Bullet injuries form a subset of trauma care, and it can affect any part / organ of the body from scalp to great toe i.e. skull and brain, face (maxilla, orbital structures, naso-ethmoid, Mandible, dental elements), neck (Cervical spine, Major vessels, pharynx, esophagus, trachea), chest (heart, lung, aorta, IVC, spine and spinal nerves), abdomen (gut, solid organs, vessels and spine/spinal nerves, retro- peritoneum), pelvis (Gut, urinary bladder, uterus, prostrate, pelvic bones, head and neck of femur), limbs (brachial plexus, vessels, muscles, tendons, bones, joints).Very few doctors can handle all regions of the body competently. The reason is the trade-off i.e., compartmentalization of the sphere of general ‘competence in the endeavor to achieve a very high-level of special‘ competence in particular aspects of a body. This is explained below.

LIMITATIONS IN COMPREHENSIVE TRAUMA CARE DUE TOSUPER SPECIALISATION

15. Surgical Super-speciality training is primarily organ / tissue specific e.g., Neurosurgeons & Neurophysician treating nerve and brain derangements, Urologist & Nephrologist treating kidney diseases, Medical & Surgical Gastroenterologist treating Gut, Liver and Pancreas, Cardiologists & Cardiac Surgeons treating heart, ,endocrinologists and endocrine surgeons treat gland disorders, ENT specialists treat Ear, nose and throat, Eye specialists are limited to eyes, Gynaecologists to uterus, cervix and ovaries and so on. Some superspeciality by its inherent nature are required to explore all types of anatomical areas e.g., Vascular surgeons, Surgical & Medical Oncologists, Plastic surgeons, and Trauma Surgeons and can handle problems in multiple areas better, but still have limitations [12]. Thus, the arrivals of so many super-specialties have no doubt enabled advanced Medicare, but have robbed the general specialists of the opportunities to explore into multiple fields of the body and acquire the confidence to handle difficult situations. On the other hand, abilities of super-specialists have touched an extraordinary level of excellence compared to the best in the world in handling parts of the body in their core areas. However, making ATLS certification mandatory along with the requirement of compulsory work in a recognized trauma centre for 5 days every 2 years for all if made mandatory to maintain their license to practice, will increase the talented and accomplished pool of doctors in trauma care, which will be good for the nation in the long term in both war and peace.

IMPACT OF CONSUMER MOVEMENT ON TRAUMA CARE

16. Pressure by family members of trauma victims to be seen only by a super- specialist once the victim reaches the emergency department combined with misplaced consumer activism, interventions by consumer court and the consequent fear of prolonged litigation have no doubt taken its toll. Nobody attempting to save life by an honest effort would like to be labeled as incompetent due to limitation of available equipment or staff and due to other organisational resource crunch, on which he has no control. The result is disinclination, and, over a period of time an inability of a general surgeon in general to handle a non-compressible‘ trauma confidently. This has become a major limitation in management of trauma in general and impacted the ability to handle GSW / explosive blast injuries in the hinterland of India from where a large number of patients are unable to reach well-equipped trauma care centers in time.

CHANGING PARADIGM IN TRAUMA CARE DUE TO WAR AND TERRORISM

17. GSW / blast injuries in warzones/special operations differ from civilian injuries in many ways in the severity of injuries. However, the number of terrorist attacks and suicide bombers detonating themselves in public have brought home the prospects of sustaining multi-organ trauma in various combinations, and of various severity and complexity a reality, even in civilian life. No one is immune to firearm injury and it will strike without warning. The wars of the 21st century, especially the Armenia- Azerbaijan war, and the Russia Ukraine war, have also brought home the bitter fact that modern wars are likely to be prolonged affair. Further deaths will now occur not only in the FEBA (borders) where the enemy is in eyeball-to-eyeball contact, but equally in depth, as the military targets are being hit by drones and Quadro / Hexi / Octa / Multi / Hybrid copters easily up to 100 km inside the border due to their progressively extended reach. Similarly, the reach of the modern missiles and, various forms of guided munitions of our adversary now covers up to almost 1500 km, i.e., practically the whole of our country and hence, theoretically all parts of India will constitute part of an extended warzone in a full-scale war. Increased and determined efforts of the enemy to hit valuable strategic targets like parliament, oil refinery, stock market, in an attempt to break the will of the adversary, especially in urban areas, is a reality and will beyond any doubt result in widespread collateral damage. The government has to take cognizance of this and act. Policy makers have to carefully frame a comprehensive and realistic policy on this account by constituting a high- powered task force at the earliest.

IMPACT OF SOCIAL CHANGE ON INCIDENCE OF CRIME

18. The instability of the social fabric due to the aspirational upwardly mobile population of India may increase the incidence of violent crimes. This may be further fuelled by the easy availability of small firearms (indigenous as well as foreign made), both legal as well as illegal. Hence a progressive increase in the crime rate is inevitable unless urgent corrective action is initiated. Further, since nobody is insulated from firearm injury in the absence of predictability in time and space, social reformers have a big role to play.

HOW TO STRENGTHEN NETWORK AND ACCESS

19. Even if all diseases are conquered, injuries will never fade away. In fact, Gun- shot and blast injuries will become more and more destructive as time passes with ¯scattered

pellets, clustered shrapnel's, and many newer forms of destructive abilities. This requires India to become ready and develop a robust workable competence-based region-wise chain of trauma care echelon, with information about its working widely disseminated and in real time leveraged by all citizens using a widely available and free app mandatorily put in all the mobile phones sold in India with video of basic measures along with an interactive option to seek help at the location of the injured as well as to revise intervention measures. This should be combined with a very robust network of emergency care ambulances so that victims can reach the appropriate centre as quickly as possible, preferably within the golden first hour. Similarly, all public transport drivers and attendants must be given basic training to stop bleeding and maintain airways as part of a licensing exam. Besides this, they should, by law, need to know the main as well as all the alternate routes to reach the nearest trauma centre in their permitted area of driving so that no time is lost.

20. There are multiple applications available for Geo Tagging a person's current location. One such application is to be identified/ created de novo and exclusively used for trauma care purposes by incorporating this as a Non -Erasable and mandatory features for all mobile phones and smart watches sold in India. The application should be developed in multiple regional languages. It should be linked with a voice alert feature "Help me" in addition to a use of key/ tap which will activate a "first response " and simultaneously show on mobile screen the location and identity of the nearest trauma care facility along with access road to reach there as with Google map. The screen in the mobile should also pop up an Alarm button which when tapped should initiate the "Second Response" which does four actions. (a) Emits loud call for help by bystanders (b) Automatically sends an SOS message and a call to the nearest emergency response team along with its designated Ambulance team (c) Activate the camera of the mobile for visual inputs (d) Switch on the current location, so that the EMR team can track it's location real time if he has been moved by passer-by.

21. Similarly the Emergency response team should be able to quickly respond and after quick assessment not only send a message to the higher echelon trauma care facility so that it is forewarned, but also render continuous help while in transit. The Emergency response team should have the ability to log on to the local Police Network for safety requirements and to the traffic police for Road Clearance / diversion measures, so that precious time is not lost. By adopting the above, the referral problem is dispensed with as the EMR team is the decider followed by the Trauma Care Centre.

IMPORTANCE OF COMPLIANCE TO FIREARM REGULATIONS

22. The Indian Firearm Act is one of the strictest Firearm control provisions in the world. No citizen of India has a constitutional right to own firearm, as is the case in the USA and in some other countries. Criteria for approval of a firearms license may be made even more stringent. All weapons with the caliber of .22 and above should need a license. Similarly, all Air Guns which are capable of delivering 20 joules or more of muzzle energy /with a caliber more than 77 should require a license.

23. UP, Punjab and the state of J&K has the most number of licenses, but also have the maximum number of illegal firearms. Insurgents in states like Manipur as well as Left Wing extremists in the state of Chhattisgarh possess a large number of illegal firearms and IEDs. Mirzapur is considered the biggest Hub of illegal weapons. Koduvas are

apparently permitted to carry firearms without license in view of them being considered born warriors by the British Raj. This if still in vogue, needs to change.

24. In India, license for non-prohibited bore weapons (NPBW) (bore refers to the diameter of the bullet) is issued by civil police/ DM/State Govt as applicable and, as per Arm Act 1959 and Arms rule 1962, one can carry it if there is a perceived threat to his life. Only 2 firearms can be issued on one license, whereas prohibited bore weapons (PBW) like Pistol (9mm) and handguns (.38 and .455) are issued by the Ministry of Home Affairs and only 50 cartridges can be legally issued per annum (max of 30 cartridges at a time). Further the Indian Arm Act 1959 prevents any citizen from carrying any pistol or gun that is self-ejecting. Also, sons / daughters are not permitted to carry the father‘s/ mother‘s firearm. In India, it is not legal to carry firearms in public, although this is violated with impunity. Possession of unauthorized firearms is punishable by imprisonment of 7yrs to 14yrs in addition to a fine. Similarly, whenever the owner dies, his firearm is required to be either transferred or surrendered to local police. No firearm is permitted to have more than a 6-inch sharp edge on any end. Firing a gun in the air has been made illegal in some states like UP and others should also follow suit [13]. These licensing laws are thus, sufficient, but needs to be implemented in letter and spirit. This will require immense political will and concerted effort towards enforcement of the law.

IMMEDIATE INDIVIDUAL RESPONSE TO BLAST INJURY

25. There are some protective measures that can be adopted by citizens in general to avoid injury in the event of a threat by bullet / blast. Citizens may be taught, as part of reflex behavior, to lie down flat on the ground with their head away from the direction of sound of bullet / blast (reduces target area and protects head and eyes). They should not panic, but on the first opportunity, they should take cover in the nearest safe area and contact police using emergency fast dial on t h e phone. If they notice any casualty in their vicinity, they should be able to act as per the needs of the situation and pull him to a safe zone. Thereafter the measures to be adopted by common man to prevent death within the Golden hour (for bullet injuries) and within Platinum minutes (for blast injuries) are adherence to the simple and easily followed provisions of basic life support. The same is given below.

BASIC LIFE SUPPORT

Steps of BLS:

a) Quick initial assessment by the first responder is important. First check to ascertain the scene safety, look for debris, shrapnel and the presence of any malicious intent to harm.

b) If the scene is considered safe, tap on the shoulder and speak to the victim loudly to ascertain whether the individual is conscious and responsive.

c) Call for professional medical help and an ambulance.

d) **STOP THE BLEEDING**:-The first action should be to stop the bleeding by compression of the wound with a clean cloth available next to you, and elevate the limb.

Apply a cloth tightly proximal to the wound to reduce blood flow if the leg is burst and bleeding.

e) Look for a satisfactory chest rise and whether it is also equal on both the right and left side with breathing effort. If present but the patient is unconscious, clean the mouth with a dry handkerchief to reduce the chances of airway obstruction and put the individual in a coma position to reduce the chances of the tongue falling back to obstruct the airway as well as vomit being aspirated in the lung. An unequal rise in the chest indicates pneumothorax and constitutes an emergency requiring prioritization of need to reach a nearby hospital.

f) Check for evidence of cervical spine injury. Keep a close watch on breathing effort. If the breathing has stopped, immediately initiate CPR after checking the carotid pulse as per teaching of BLS. If a pulse is present, continue with rescue breathing only. If a pulse is absent, conduct high quality chest compression (30 times) on the sternum ensuring adequate chest recoil to enable the lung to be filled with air followed by 02 rescue breath. Continue the same for at least one hour/ placement on a ventilator, whichever is earlier, continuing to watch for and manage bleeding from the wound simultaneously.

g) This CPR is to be continued by passer-by in rotation (too tiring for a single person), till an ambulance/equipped doctor/ paramedic reaches you.

Note: - Rescue breath is of no use if the heart does not carry the blood (Oxygen) across to other parts of the body. Hence, in effect, CPR is a delicate balance between forcing the heart to start from under the ribs while being gentle enough not to puncture it. Hence, this simple CPR+ BLS course is a must for the general public to know and must be incorporated into all First Aid courses properly to attain the status of 100% informed citizenry. Once inside a hospital, the action in terms of trauma protocol needs to get activated.

BASIC TRAUMA LIFE SUPPORT (BTLS)

1. BTLS differs from BLS in that it trains the learner to **STOP THE BLEEDING**, assess deformities (abnormalities in the shape of a body part or organ compared to the normal shape), contusions (bruising which in extreme cases may lead to significant blood loss with blood leaking into surrounding tissue), abrasions (may be simple or contaminated with IED debris), puncture/ penetrations (ability to opine that the object did not pass through), perforations (when searched consciously to find whether the object has passed through with an entry and exit wound), burns (extent and degree), lacerations (how deep below the skin and likely underlying structures it could have damaged), tenderness (may be muscle tear or a fracture etc), swelling (due to blood collection, expanding hematoma etc) on a scientific and analytical manner with focus on what to suspect and act accordingly . This involves critical thinking and objective assessment of firearm injuries by looking for clinical presentations other than ABCDE (Airway, Breathing, Circulation, Disability & Exposure) taught in BLS. The student is also taught to handle immediate post traumatic shock episode which occurs on seeing the dead bodies and ghastly injuries strewn around in a major blast injury and is at times a cause of sudden death on account of very intense adrenaline surge (Broken Heart Syndrome).

2. Military surgeons are conversant with the correct approach to treat trauma by virtue of their training, since the Armed Forces put a lot of effort into training their soldiers and paramedics in BTLS, Nurses in ATCN (Advanced Trauma course for Nurses), and doctors in ATLS (Advanced Trauma Life Support). In the last few years, AIIMS JPN Apex Trauma centre and some other similar Institutes have spearheaded the effort to disseminate knowledge in the field of trauma care in both military as well as civilian centre. This effort needs to be not only sustained, but expanded as much as possible.

3. **Need for Advanced Teaching and Training**: Training (skill development) and teaching (achieving theoretical clarity of the subject matter) are an integral part of any progressive effort and is required to be sustained to maintain the gains achieved. The National Board of Examinations has recently begun registering courses in trauma care, although in a very limited manner. Similarly, Paramedic training although done at many institutions, lacks accreditation, structured review programme, or assessment for periodic update of skills and knowledge in the field of trauma, and bullet / blast injuries. Hence, their actions, howsoever well meaning, get translated into widely varied and individualized treatment meted out by the first responders, including attending doctors unsystematically (although with good intention), leading to preventable deaths. This is reflected in the glaring fact that in Mumbai terror attacks, out of a total of 271 casualties encountered, 175 people (including 9 terrorist) died,108 were dead after admission (68 due to bullet injuries,30 due to blast injuries and 10 had both). Six postoperative deaths were all due to GSW. This indicated that the impact of severe bullet and blast injuries could not be addressed adequately and potentially salvageable patients could not be operated within the acceptable timeframe.

ROLE OF CIVIL DEFENCE VOLUNTEERS

4. The members are usually nationalist, motivated and well-meaning citizens. However, there is a paucity of trained personnel among the civil defence forces who can provide BLS or BTLS. This captive and easily identifiable group must be given organised training.

TRAUMA CARE ONCE IN HOSPITAL

5. The **super-specialist doctors** of the country are fully competent to tackle complex trauma, when it pertains to their own field of expertise. However, only a miniscule proportion of trauma victims are able to reach well- equipped super- specialist care facilities since such superspeciality centers are all located and clustered in big cities where patients of all types of illness come from villages, rural districts, towns and tier 2 cities [8,10,15 &16].

6. Those super-specialists who work in the suburbs of cities, and in smaller towns work by and large in a relatively modest private set-up which often do not have the technical/ medical equipment and supporting facilities, including trained staff required to treat complex trauma like cardiovascular and lung injuries, complex pelvic or brain trauma, or major abdominal solid organ and large vessel tears, and hence are unable to utilize their available domain expertise fully which often results in preventable death.

7. However, General Surgeons and Orthopedic Surgeons form the mainstay of medical professionals available in non-metros and are now imparting primary care as well as

conducting definitive surgery in the field of GSW. On receipt of complex firearm induced trauma, if definitive surgery is not feasible, they try their best and conduct damage control Surgery and can do a reasonable job provided they have acquired the expertise to treat trauma involving all areas of the body during their postgraduate training or have undergone a course focused on treating complex trauma. This is a very important point since this group of professionals forms the most important intervention echelon in the width and depth of the country who are able to save lives in a very significant way by **successfully stopping a major bleed**, and, combating shock and if required in helping/ transferring the patient to a proper trauma care facility. GSW and BI victims require ICU care both at admission and in post-operative care. A survey showed that only 47% of district hospitals (>300 beds) and only 5% of district hospitals (<300 beds) had an ICU of reasonable standard.

TRAUMA CARE CENTERS IN INDIA

8. District hospitals in India were designated as level III Trauma Care Centers in 12th FYP, which were to cater for initial evaluation and stabilization of an injured. medical colleges & hospitals with bed strength of 300 to 500 were identified as Level II Trauma Centers with a commitment providing facilities to provide definitive care for severe trauma victims with in-house emergency physicians, surgeons, orthopedic surgeons and anesthetists. The medical colleges and hospitals with more than 500 beds were planned to have a Level 1 Trauma Centre to provide the highest level of definitive and comprehensive care for patients with complex injuries. However, this has not been fully realized and the same has been highlighted in various reports. Police records give a fair indication of areas with a high number of Gun violence. The recommendations of Niti Aayog‘s report on ¯Emergency and Injury Care at Secondary and Tertiary level Centers in India has although focused on road accidents in a major way, it should also be integrated into the trauma care framework. The Local Government, at least in urban areas, must be armed with a dynamic strategy whereby, from these areas the victim of firearm injury is able to be shifted to a trauma care facility within 30 min.

9. As per a TOI report published in 2017, in Maharashtra, out of 18 trauma care centers, only 3 were adequately staffed and functional, the rest were either non- functional or partially functional due to inadequate manpower, or shortage of infrastructure [19]. Other reports have also flagged the issues of inadequacy of trained manpower, lack of essential equipment and training [8,9,10 &15].

10. A report stated that only 33% of District Hospitals (>300 beds), had emergency operative services for trauma patients [4]. In such a scenario, ability to manage injuries on account of explosive devices, IEDs, Bullet injuries and bomb blasts is in serious question.

BLOOD BANK FACILITIES

11. The blood bank is an essential component of trauma care. Out of 34 assessed district hospitals, in 15 district hospitals, the blood bank was not available 24x7, only 4 had an emergency blood transfusion protocol and only 5 had a massive blood transfusion protocol. Blood banks in larger cities but housed as a corporate/ private entity are doing much better in terms of availability as well as accreditation.

DISASTER MANAGEMENT DRILLS & POLICIES

12. Mass shootings and blast injuries can easily overwhelm the resources of a normal emergency department and, the conduct of regular drills to face such disaster management provides the opportunity to plan, prepare and when needed, enables a rational response in the case of disasters/ mass casualty incidents. Disasters and mass casualties can cause great confusion and, introduce inefficiency in the hospital. However, the capacity to cope with such scenarios exists in only about 35-50% of district hospitals. This capacity needs to be increased in collaboration and coordination with disaster management agencies of the district, state and India, Railways, Civil Aviation, NDRF, Military and Paramilitary organizations.

VIEWS OF WORLD HEALTH ORGANISATION ON TRAUMA CARE

13. IATSIC (International Society for Trauma Surgery and Intensive Care) is an integrated society within the broader international society of Surgery and provides guidelines targeted at administrators, ministries and policy makers under the umbrella of WHO and from time to time, updates the guidelines for trauma quality improvements programme. The report says that 5,800,000 people die of injury every year in this world, with the burden being excessive in low and middle-income countries.

14. The WHO guidelines bring out the core essentials of trauma care services which every person in this world should realistically be able to receive, even in the lowest income setting, and exhort member states to improve their trauma care systems using an affordable and sustainable programme, identifying problems especially related to system issues, developing reasonable corrective action plans, following through on implementing these plans and evaluating whether the corrective action plan has had its intended consequences. It has also suggested creation of a death panel review to identify the factors of care that needs to be strengthened, adoption of a modern QA programme especially focusing on patients who have died of low injury severity scores. WHO also has a designated department of Violence and Injury Prevention and Disability (VIPD) which issues updates from time to time.

15. India needs to form a similar body and leverage its immense advancement in the field of Information technology, AI and software development capabilities, and aim to form the largest database in the field of trauma in the world with GSW and blast injuries being a subset, where records of various agencies, courts, cremation and burial ground, forensic science services, hospitals and medical colleges may be integrated. This will be a big step not only in improving the care of firearms injuries, but also form a robust database which will be beneficial in achieving a larger purpose of maintaining the security of the country.

AVAILABILITY OF AFFORDABLE EQUIPMENT

16. Assured and timely availability of technologically and scientifically sound equipment and supplies of medicines and consumables is an essential component of trauma care. Studies have shown that overall mortality decreased by 15–20 % and preventable deaths were reduced by 50 % with improvements in planning and organization for trauma care. Development of high quality and innovative home- grown technology will play a big role in making trauma care affordable for the middle and lower sections of society.

17. There is a felt need for lower costs, more durable, and easier to repair versions of many medical devices used in trauma care like Oximeters and Ventilators. Indigenization can decrease cost and increase the availability of a range of equipment. Innovations with t h e use of disruptive technology will be a game changer. This is more important in GSWs and BI where control of bleeding is achievable with minimal invasive procedures.

18. In a study of medical colleges/ tertiary care centre, most of the Hi-Tech equipment was found to be mostly imported. Approximately, 90 – 95 % of USG and CT scan which have been considered essential for last 40 years, are still largely either imported or are being sold with minimal make in India component of key parts. This is something which is very difficult to accept in a country full of such a high talent pool in the field of electronics and computer technology. This needs to be addressed on a war footing. The import of foreign equipment also poses a challenge for repairs and maintenance. This leads to a significant down-time. Moreover, due to economic reasons and lack of training, the cutting-edge technology fails to penetrate the Indian market and phased out and refurbished devices are more commonly marketed in the hinterland of India, which are the usually old models phased out from tertiary care hospitals of big cities of India and abroad. Hence, local production with emphasis on Make in India‘ is a necessity which can no longer be ignored any more to increase the availability of these important technologies and make the facilities available and affordable in middle- level towns and villages of India. Low investment field like Trauma Care in the private sector needs the availability of low-cost equipment produced in India for it to succeed for poor people.

19. The availability of indigenous ventilators and other lab equipment was made possible in the COVID 19 pandemic with firm government policies. The market size of the medical devices sector in India was estimated to be $11 billion (approximately, ¹ 90,000 Cr) in 2020, but its share in the global medical device market was estimated to be only 1.5% [21]. This is expected to reach 100 billion USD in the next 10 years as more hospitals come up in the hinterland, causing precious loss in foreign exchange. It is time for India to take a leap forward in the field of manufacture of medical equipment by increasing investment in research and development if we are to achieve a reasonable national aim of 100 billion US dollar (Rs. 8,500,000,000,000) industry in this sector simultaneously enabling a large number of medical equipment to reach the small towns and villages, thereby taking the level of care in villages much higher. This will be a great feat towards the goal of affordable health for all.

REQUIREMENT FOR POLICIES / PROTOCOLS ON CONDUCT OF AUTOPSY

20. There is a national programme for prevention & management of trauma & burn injuries (NPPMT&BI). However, exclusive standard policies and protocols for treatment of GSWs/BIs are lacking in its role. Most of these victims are treated by in- house‘ protocols of the facilities and are guided by the expertise available in the hospitals. Similarly, there is no policy on the conduct of autopsy. The lack of national policy regarding autopsies has led to significant variation in the number and proportion of autopsies performed at dedicated centers. Autopsy rates seem to vary greatly across cities and regions, as do the proportions of autopsies involving firearms deaths. Imphal, the capital of Manipur, exhibits the highest rate of autopsies on gunshot victims; 42.5 per cent of all autopsies were carried out on murder victims, while a lower yet still impressive proportion involved firearms murder victims. It may be relevant that

Manipur is home to the highest firearm murder rate in the country. Whereas Imphal stands out based on its uniquely high recourse to autopsy for victims of firearm murders, a large number of victims in other parts of the country do not undergo autopsy as a result of which the correct pattern of injuries suffered by GSWs / BI is not reliably available. Hence, a policy needs to be implemented where all GSW/ BIs must be subjected to a limited postmortem focused on the area of interest. If the postmortem is not done for any reason, whatsoever, a whole-body CT scan must be made legally mandatory, prior to burial/ cremation so that the broad nature of injury and the likely cause of death can be reliably documented.

APROACH TO THE MANAGEMENT OF GUN-SHOT AND BLAST INJURY IN MILITARY ENVIRONMENT

1. In GSW, injuries amongst individuals using BPJs (battle protection jackets), 60% involve extremities. In other instances, 60-80% of injuries involve the chest and abdomen, which constitutes a wide and unprotected target area, which cannot be compressed satisfactorily to stop haemorrhage.

2. Just as self-care (e.g., packing of shell dressing and use of self-applying tourniquet) and buddy care (like raising legs and applying pressure) are life- saving intervention in battle, informed medical assistance and first aid by passer-by and fellow citizens in civilian life can be of immense use in stopping bleeding due to GSW. Hence, citizens must be trained to use belt/ rope/scarf/ piece of cloth torn out from worn fabric for tourniquet & packing of wound with clean cloth to **STOP THE BLEEDING**. Similarly, wider availability of IFAK (Individual first aid kit) in all motorized vehicles (@1 kit per passenger) may be made mandatory so that it can be used in an emergency by any vehicle owner while transferring a victim to hospital.

COMBAT SCENARIOS

3. In the Korean War, which lasted over 3 years, out of 40 lakh casualties, 20 lakh were civilians indicating the brutality of the war. In the ongoing Ukraine Russia War, which has now touched 600 days and counting, the total number of casualties due to bullet injuries and explosive action has already crossed 3,50,000 with about 56,000 killed in action (KIA) and about 2,50,000 wounded in action (WIA) indicating a 15-17 % KIA rate in the larger context, out of which about 20% were collateral damage i.e., civilian death (9444) which is noteworthy and since most of the death occurred in cities and towns (denser population), must be taken seriously. Only about 15% of soldiers could go back to join the battle (RTD-Returned to duty), causing a serious shortage of troops ready to fight again, one of the lowest rates of RTDs compared to previous wars. Further, about 85% were either maimed or were dead, which is one of the highest in modern warfare. This is alarming in a war that is showing no sign of stopping with many more likely to be affected in the same proportion. This extraordinary high rate is due to the large number of explosions due to higher generation weapons with much more destructive power i.e., missile / rocket / drone/ air craft / tank actions conducted up to 300-400 km inside boarder and in urban areas. India is a country with an urban population density much more than Ukraine or Russia. If we as a country have to face a similar situation, our death rate of the civilian population would be many times more. This is the New Normal‘ and is likely to be reflected in any future conventional conflict between India and its adversaries. Hence, we must be prepared for it.

4. Firearms and explosives kill or maim the victims either intentionally or accidentally. The immediate concern is death, either due to blood loss or due to inability to breathe or due to the major disruption of organs in any of the 3 cavities of the body. i.e., cranial, chest and abdominal cavity, when the extent of loss becomes incompatible with life. Associated bone, nerve, vessel, muscular and maxillofacial disruptions may contribute to death in an immediate time frame, although by themselves they may not be the cause of death. However, it may result in disability in a long-term time frame. Bala et al reported in a study of 181 patients with abdominal trauma after a terrorist bombing attack amongst the civilian population in Israel who required laparotomy on admission to Hadassah Hospital Jerusalem Israel, in the 5yr period from 2000 – 2005, there were injuries to multiple body regions in 87.5% of cases, with shrapnel being the leading cause. In the same hospital, the pattern of thoracic injuries consequent to suicide bombing attacks resulted in 52.7% of the patents sustaining lung contusions and 45.5% of victims requiring tube thoracostomy, reemphasizing the requirement of all medics and paramedics to be trained to perform the relatively simple procedure of Needle thoracostomy and Tube thoracostomy on-site as part of BTLS (Basic Trauma Life Support).

5. The approach to the problem is different in battlefield, rural and urban settings since the type of injuries as well as the availability of facilities to manage the trauma are variable. However, the basic principles of staging casualty care remain the same. These are explained in detail in the succeeding paras.

6. It is a paradoxical fact that, upon the least trained, falls the most important responsibility of saving life and managing bullet injury, since the best position to become the first responder is usually the bystander. But if the first responder fails in his duty, the responsibility of first response falls on the primary care doctor to whom the victim is taken, but after paying a heavy price i.e., loss of precious time where a victim continues to bleed. Hence, correct decision making by the bystander is the single most important factor which impacts the survival of an individual facing severe blood loss and organ disruption within the golden hour and at times within the platinum 10- 30 minutes. Hence, it is necessary to clearly form robust guidelines for casualty care at all levels in a large country with diverse topography like India where the barriers of timely care are different for Plains, Hills, Deserts, jungles, islands, hinterlands, heartland and border areas due to different time taken to cover the same distances by road /foot/ boat. Similarly, the problems of managing battle casualty in war and conflict zones (both civilians and Armed Forces) and managing crime scene casualties (both Police and Civilians) are different and need to be addressed carefully.

TACTICAL COMBAT CASUALTY CARE PROTOCOL (TCCC)

7. TCCC covers three major aspects of standard of care for modern battlefield/ terrorist operations. These are:

   (i) Care under Fire (CUF)

   (ii) Tactical Field Care (TFC)

   (iii) Tactical Evacuation Care (TACEVAC)

However, it must be appreciated that these are only guidelines and are not asubstitute for sound clinical judgment.

8. The medico-legal, forensic and investigation angle to the issue is gaining importance and it is time we put special attention to this aspect so that the culprits do not get away. Fear of getting caught / identified and getting punished is a very important aspect in the reduction of crime. Education & awareness programme from school level & adoption of personal protective measures to reduce impact e.g., lying down on the ground in civilian life on the sound of gunfights and adoption of special measures amongst police and armed forces will also reduce the injury rate. The wider use of surveillance cameras and an increased number of well-equipped forensic science laboratories in every district will become a deterrent to crime to some extent.

9. The future threats, advances in firearms and explosives and newer and ingenious methods to inflict damage need to be weighed closely and factored in a structured and sustained manner as a state policy. Corrective measures need to be instituted on a continuous basis with periodic up-gradation. Training and adoption of the MARCHE protocol with widening the network of training in BLS/ATLS/ATCN as a mandatory component of life skill training from early days of schooling is important.

10. For casualties occurring in remote areas, a clear doctrine of optimal usage of casualty care resources is required. It is essential to move the life- saving elements to the point of incident‘. Putting undue emphasis to quickly shift to nearby hospitals in order to save life, over that of securing vital elements i.e., respiration, bleeding and spinal stability, is to be discouraged. Hence, there is a need to invest heavily in Far Forward‘ casualty care, if preventable death is to be reduced & specific action is initiated towards this prior to evacuation by road / air. This is most essential to obviate delayed medical intervention and improve survival.

11. Once a patient reaches a primary care echelon, doctors and nurses must possess higher order skills in 10 areas, and all items required to achieve it must be available on the ground. This is applicable for both civilian as well as military environment.

    (a) Ability to intubate a patient

    (b) Ability to place IV drips & central line & manage shock

    (c) Ability to place a thoracostomy needle and chest tube

    (d) Ability to pack abdomen and place a binder to stop an ongoing bleed

    (e) Ability to pack an open bleeding wound by haemostatic dressing and apply a tourniquet correctly

    (f) Ability to stabilize spine and limb

    (g) Ability to do percutaneous tracheostomy and cricothyroidotomy inmaxillofacial injuries with flail jaw and tongue fallen back

(h) Ability to catheterize / do suprapubic percutaneous cystostomy

(j) Ability to relieve pain without undue sedation.

(k) Ability to safely transfer victim to the next trauma care echelon

12. The structure and quantum of medical support needs to be flexible and pegged with population concentration, limitations of reach due to terrain constraint and the anticipated intensity of combat/ terrorist damage. Further, the evacuation request once given should materialize by a clear algorithmic approach in to a non- threatened sector/ area, which has a better trauma care facility. This facility may be a military / civilian hospital (private / public) and must be integrated into the war planning. Modern wars are fought by Nation as a whole‘ approach with armed forces, paramilitary, airlines, ship industry, industrial complexes, ISRO, NTRO, DRDO, and the role of more than Indian 1,00,000 doctor, nurses and citizenry must be clearly defined to fight the threats faced by an emerging power who aims to redefine the world order.

13. Interaction between civilian medicare set-up and military organizations in peacetime as a part of national effort needs to be expanded and the capabilities of each other leveraged. These organizations which form the sheet anchor of medical care in India must integrate in a major way and also incorporate the private sector in the effort.

MANAGEMENT OF GUNSHOT AND BLAST INJURIES

Basic Features of Explosion and Blast Injuries

14. Higher order explosives (HOE) like TNT, C-4, Semtex, Nitroglycerine, Dynamite, ANFO (Ammonium Nitrate Fuel Oil) produce supersonic blast waves which cause direct damage e.g. Lung rupture, GI perforation and hemorrhage, ear damage by rupture of tympanic membrane, disruption of the middle ear, rupture of the globe of eye as Primary‘ damage due to direct impact of blast wave. Secondary‘ injuries may occur due to impact of projectiles i.e., damage may occur due to flying debris and fragments which can lead to penetrating / blunt injuries and fractures in any part of the body and Tertiary‘ injuries as the individual gets thrown by the blast wind, leading to head injury, visceral injuries, fracture and traumatic amputations. All of the above and also the impact of other mechanisms/ circumstances can lead to Asphyxia / crush injuries / burns / sudden aggravation of existing medical conditions termed as Quaternary‘ injury. LOIE‘s (Low Impact Explosions) e. g Pipe Bombs, Molotov cocktails and gun powder have much lesser blast effect.

Primary Injuries

15. Blast lung: - It is diagnosed by a clinical triad of apnea, bradycardia & hypotension and confirmed by the characteristic butterfly‘ pattern on Chest X- ray. It may also present as dyspnea, cough, hemoptysis and chest pain. Prophylactically chest tube is recommended to be placed prior to transfer by air or before general anesthesia.

16. Blast ear: - It may present as sudden tinnitus or deafness or ear bleed due to Tympanic membrane perforation, or as vertigo or otalgia or a different combination of the above.

Sudden deafness may occur requiring use of the written mode of communication in an otherwise normal individual.

17. Abdominal injury: - Gas containing bowl may perforate and solid organs may rupture e.g., Liver / Spleen / Testes. Acute presentation may be as severe pain abdomen of sudden onset or unexplained hypotension/ hypovolemia and after 24 hours may present with signs of peritonitis and after another few days with signs of sepsis. Hence element of suspicion must be there to diagnose this in an otherwise normal bystander near a blast injury reporting to a doctor.

18. Brain injury: - MTBI (concussion) without any direct blow to head may present as headache, fatigue, poor concentration, lethargy, depression, anxiety, insomnia, and other symptoms of PTSD. This must be kept in mind since there are no overt injuries.

Non- primary blast injuries

19. Any organ/ tissue may be injured. Hence, the clinical presentation may be of an unconventional pattern. This may be
    - As visible in a penetrating trauma,
    - As features of blunt trauma with or without inspectory findings
    - As air embolism presenting clinically as stroke, MI, acute abdomen, blindness, deafness, spinal cord dysfunction or claudication
    - As burn injuries
    - As acute renal failure
    - As compartment syndrome with tense painful / anesthetic/ pulse less limb
    - As features of carbon monoxide (inadequately burnt coal) / cyanide (burning plastic) poisoning if the incident occurs near ammunition storage points and presenting as confusion, headache, difficulty in breathing, cyanosis etc.

Important points in Management

20. All Medics and Paramedics should be mandatorily trained as part of their Degree / Diploma / Certificate programme in Trauma Life Support courses and learn MARCHE protocol.

21. Recognition of gurgling sound in the throat as an impending airway obstruction and the importance of placement in Coma Position (recovery position) as a reflex behaviour amongst citizens cannot be overemphasized. In fact, the ability to demonstrate BLS capability by students in schools should be rewarded with additional marks from Class VIII onwards as recognition of a very important skill level.

22. Ability to **STOP THE BLEEDING**, insert I-Gel, secure IV lines, give fluids, splint fracture, tie a pelvic binder and insert a needle (in second intercostal space) to decompress a pneumothorax does not require a great amount of training in an aware,

intelligent, confident and rising Indian population. This can become part of Class Xth, XIth, and XIIth curriculum and practiced on interactive mannequins available as Make in India‘ product. This has been validated to be an achievable skill amongst interested non- Medics with no formal training in the field of medicine.

MARCHE PROTOCOL

23. All doctors, nurses and paramedics must mandatorily become competent in resuscitatory techniques and follow a standard protocol to minimise omissions of vital steps in care of the injured. This may be combined with a check list for assurance and reduction of unintended errors.

M (Massive Haemorrhage): STOP THE BLEEDING by application of haemostatic dressing (chitosin / kaolin based dressings) and tourniquet and Inj Tranexamic Acid 1gm IV over 10 minutes in the event of massive bleeding and if required, repeated hourly to a maximum of 8 hours.

A (Airway): Perform head tilt, chin lift and jaw thrust maneuver to open the airway, insert Naso-Pharyngeal airway, suck out the oral cavity clear of secretions to prevent aspiration, exclude spine or pelvic injuries and place victim in recovery position. In extensive maxillofacial disruptions, use of Naso- Pharyngeal Airway (NPA) / IGel / ETT is not usually feasible and hence training of Cricothyroidotomy in manikins/ simulators is important which a person can replicate in a real life saving situation.

R (Resuscitation): Needle decompression by 18G or 16G intracath or BT needle in the triangle of safety‘ [With the arm abducted, Anterior axillary fold (lateral edge of Pectoralis major) & posterior axillary fold (lateral edge of Latissimus dorsi) diverges as it descends from the apex of axilla. Its intersection with a horizontal line at the level 5th ICS (level of nipple in males)] forms a triangle. A needle introduced at the upper border of ribs within this triangle saves the life of a tension pneumothorax patient, exposed to GSW / nearby explosion by converting it technically into an open Pneumothorax. Similarly, insertion of chest tube (ICD) to treat hemothorax (3rd leading cause of death) should be a mandatorily acquired ability for medics, nurses, and paramedics.

The ability to perform this simple procedure along with CPR and stoppage of bleeding should be validated every 5 years and linked with renewal of license to practice. If the victim does not have a good breathing effort, insertion of a supraglottic airway like i-Gel is an uncomplicated action and when combined with ventilation by self-inflating bag with oxygen and SPO2 monitor is life-saving. Any doctor who cannot do this simple action should not have the right to do clinical practice.

C (Circulation): Rising pulse and falling BP is a sign of impending shock, especially if accompanied with intense sweating, and indicates the need to infuse IV fluids to maintain BP at 70 - 90 mm of Hg systolic (permissible Hypotension) till bleeding is controlled. Attempt to elevate the BP beyond 90 mm Hg by infusion of extra fluids may restart a bleed and hence should be avoided in field situation. Blood transfusion may be required if blood loss is assessed to exceed 1 liter.

H (Hypothermia / Head Injury): Keep the hypothermic patient warm to reduce the chances of coagulopathy and hypothermia. Treat hypothermia energetically to avoid the

lethal triad of hypothermia, coagulopathy and acidosis in polytrauma by use of thermal blankets and warm air. In a patient with head injury, instead of GCS, AVPU score is easy to comprehend for a common population i.e.

A: Alert
V: Response to verbal commands
P: Response to pain
U: Unresponsive

Head Injury patients should be maintained at 30o head up position using blankets and pillows or by lifting up the head end of the stretcher. This reduces venous pressure and ensures good venous drainage in the event of a head Injury.

E [Everything else (M-PHAAT-D)]:

M: Monitoring: - Pulse, BP & SPO2
P: Pain Management: - Using Paracetamol/ Tramadol / Morphine
H: Head to Toe examination: - To confirm / exclude additional injuries
A: Address all wounds
A: Antibiotics: - Broad-spectrum antibiotics + Metronidazole
T: Tactical evacuation preparation: - To reduce time from injury to surgery.
D: Documentation of the care given: - To provide useful information to the subsequent treating team.

GENERAL CONSIDERATIONS IN A PRE- HOSPITAL/ REMOTE / FIELD SETTING

24. (a) A normally breathing and fully conscious patient of GSW/BI with a pulse of less than 110/ min and BP of more than 90 mm Hg systolic, and absence of diaphoresis (who is not sweating profusely) needs only the bleeding to be controlled as an immediate measure. Clear mentation + systolic BP > 70mm of Hg indicates $\leq$ 30% blood loss and here IV Fluid should be withheld in field conditions as it may lead to re- bleed/ Hypothermia. Hence, only once the person reaches a hospital, a normal BP should be attempted to be achieved by giving 1 to 1.5 liters HES or Ringer‘s Lactate in an adult to achieve systolic BP of 90 mm of Hg and conduct of surgery planned.

(b) Application of a tourniquet to control a bleeding wound is generally done 3 inch (10cms) above the bleeding site, preferably on a single bone, and if it is inadequate to control bleed, tie another one above it. The junctional tourniquet is of immense value in situations where there is bleeding from the axilla or inguinal area. Similarly, haemostatic dressing applications are always to be accompanied with adequate pressure for it to be effective and, if inadequate, may either be topped‘ with a second compression dressing or replaced by a larger haemostatic dressing. Inflatable Target Compression Devices‘ are the newer addition to the armamentarium to stop bleeding and should be available in all trauma centers. Explosion induced Traumatic amputations are often associated with multiple and multi-organ injuries and hence are usually accompanied by haemorrhagic shock due to massive blood loss needing fluid and blood replacement at the earliest, in addition to all the measures given above.

(c) Pure head injury with intracranial bleed presents with bradycardia (slow pulse) and hypertension (high BP). If there is altered mental status with evidence of head injury, but radial pulse is found to be fast (tachycardia) but weak (hypotension), it should be assumed that there is a second site of bleeding (chest / abdomen / limb) which needs to be searched for. Haemostatic dressing can be either Celox Gauze or Chito Gauze or quick clot (there is no clear evidence of one being better or worse than the other). Mark all tourniquets with time of application with a permanent marker. Limb bleed is compressible bleed & torso bleed is non compressible and this must be kept in mind. A tourniquet can be applied to arms and thigh (single bones) at 250 mm Hg or 50 mm Hg over systolic BP, whichever is higher, for up to 2 hours safely. It must be emphasized that pressure above venous pressure and below systolic arterial pressure increases bleed rate from torn veins / venules and hence, raising the pressure above systolic pressure is very important.

(d) Some important points are:

- Bandage may mask bleeding due to capillary wick action and hence to be applied only when bleeding has been controlled by applying direct pressure & splint application.

- Do not remove bullet / shrapnel unless confirmed to be away from critical vascular structures on X-ray/ USG, lest it leads to restart of an earlier controlled bleed. It is better addressed in operation theatre.

- Limb elevation stops pure venous ooze.

- Compress the artery proximal to bleed for 10 minutes for it to stop and gently clamp a vessel if clearly visible. There should be no temptation to explore a wound in a state of hemostasis.

- Explosion induced fracture to be splinted to reduce bleeding and pain

- Once the patient is stabilized, wash wounds gently and dress them to reduce contamination

- Avoid wound debridement in field conditions to reduce the chances of uncontrolled bleed.

(e) Respiratory distress in an upper torso trauma merits needle thoracostomy and, if confirmatory, needs to be followed up with a chest tube. Any open / sucking chest wound should be treated by applying a vented chest seal immediately and if not available a non- vented chest seal with one side open keeping a close watch.

(f) If possible, insert a urinary catheter and seek transfer to a higher facility. Hypothermia is avoided by removing wet clothes and covering with blankets and warmers. The explosion may have led to penetrative eye injury. Do not put pressure patch here but instead just cover it with a rigid eye shield and transfer to a higher centre. Explosion induced burn injuries are common and are to be treated along standard guidelines, as are fractures due to thrown off‘ effect. Keep in mind the

possibilities of chemical / thermal injuries to t h e airways of lung, especially when a n explosion is sustained in a closed room, since this patient is likely to have chemical pneumonitis and may have to be intubated early.

(g) Safe Intubation can be ensured by adhering to the presence of essential items using a simple checklist as per SOAP ME‘ in the ambulance as well as emergency department.

S: Suction machine with preferably a Yan Kauer tip
O: Oxygen cylinder, Bull Nose fitting, Bains Circuit, Ambu Bag
A: Assortment of NPA. OPA, SGA (LMA, IGel), ETT Masks, bougiesand Stylites
P: Neutral Position especially if spine injury is suspected
M: Medication: Ketamine / Etomidate, succinyl choline/ Rocuronium, Phenylephrine, Atropine, Adrenaline
E: Equipment: Video Laryngoscope, Multiparameter Monitor, preferably with EtCO2, Cricothyroidotomy set, percutaneous tracheostomy set, Standard Tracheostomy set and Endotracheal tubes are mandatory items in an emergency department.

(h) Once resuscitated, as far as possible, use fresh whole blood to replace blood lost, since it has sufficient levels of 2-3 DPG & does not have the problems of hypothermia, acidosis, hyperthermia and high cytokine levels. The ionotrope of choice to treat hypotension in Combat Trauma is Noradrenaline EXCEPT in High Spinal Injury with Bradycardia‘ where dopamine is preferred. If a second Inotrope is required, Vasopressin should be added. Use DES solution as an interim measure if blood is not available to treat shock.

(j) Urine output is a good marker of organ perfusion. When ABG is used, base deficit & lactate level is the marker of adequacy of resuscitation. Serial hemoglobin is required to assess the need for blood transfusion to reach 8-10gm % and once this is achieved, scale back the fluid / blood to avoid pulmonary oedema / ARDS

(k) Thus, the 10 main essentials for saving lives are:

(i) Triage

(ii) Management of difficult airway (MODA)

(iii) Avoidance of the lethal Triad of Hypothermia Coagulopathy & Acidosis (HCA Syndrome)

(iv) Prevent ACoTS – Acute Coagulopathy of trauma shock

(v) Damage Control Resuscitation (DCR)

(vi) Damage Control Surgery (DCS)

(vii) Excellent Pre-hospital Care & resuscitations

(viii) Robust Transfer facility

(ix) Excellent post- operative Critical care management

(x) Rehabilitation of injured

(l) In injuries sustained in remote areas, the severity and lethality factor are much more and the evacuation to even a basic trauma care centre is usually delayed due to administrative constraints, difficult terrain, hostile environment, snowbound/ jungle/desert/marshy areas, and facilities to treat surgical trauma being located far off, necessitating provision of In house‘ & On site‘ management within the Golden hour. The positive aspects are that the injured soldiers are generally young, healthy and have good physiological reserve and, hence, if proper intervention is done within the golden hour, chances of survival increase substantively. Hence, all efforts should be made to plan timely intervention.

(m) In the event of any evacuation be expected to take a long time, it is better to stage the evacuation with periodic re-assessment and corrective actions. Use of communication (telephonic / Internet based App) helps to guide interim treatment and plan safe CASEVAC. Decide who will accompany the wounded casualty based on competency requirement. If the time to transfer to the nearest hospital is more than 1 hour, administer Inj TXA (Tranexamic Acid) 1gm (100 mg / ml) IV / IO over 10 minutes repeated hourly for up to the next 8 hrs. It works by stopping blood clots from being broken down.

(n) Special points for Ships: Care for merchant ships under pirate attack at high seas has to be given closest to the site of the operation/ incidence, including damage control surgery at sea prior to evacuation to a unit/ hospital with bigger holding capacities and better capabilities. In ships with closed compartments, explosions lead to shrapnel injuries. In the absence of Safe Zones‘ in sea, possibilities of ferrying out casualties is limited. Hence, moderately advanced life saving facilities are required to be provided, keeping in mind that replenishment is not usually possible at high sea. Hence, self- aid buddy care (SABC) has special importance with emphasis on 15 minutes of direct pressure, tourniquet, suction, IV access and needle chest decompression till doctors can attend to the victim.

GENERAL CONSIDERATIONS IN TREATMENT OF BULLET / BLAST INJURIES ONCE IN HOSPITAL / OPERATION THEATRE

25. A hospital where a bullet/ blast injury patient has arrived must always be in a state of readiness to receive him/ her. The Critical care team of the hospital on call is required to be present on the premises when the patient arrives. Hence, it will be of great value if the information of impending arrival is transmitted to the nearest trauma hospital well before by a centralized web- based helpdesk. The various actions expected are as given below

(a) Confirm readiness of combat trauma anaesthesia with use of a carefully prepared checklist.

(b) The ATLS/ MARCHE protocol is to be adhered to as given above. The main points for consideration are

- Wide bore IV access + Hb level + Grouping and cross matching
- Extended FAST (Focused Abdominal Sonography in Trauma):

  - Check for Fluid / Blood in

  o Peritoneum

  o Pericardium

  o Pleural cavity

- Start broad spectrum Antibiotic cover e.g., by triple drug-Cefotaxime+ Amikacin+Metronidazole
- Relieve pain and anxiety with Opioid + NSAID combination
- Regional anaesthesia / blocks for targeted pain relief
- Vasopressors & fluid resuscitation to treat haemorrhagic shock
- Inj TT 0.5ml if immunization status is not known

(c) Prioritize in the event of a Mass Casualty and decide

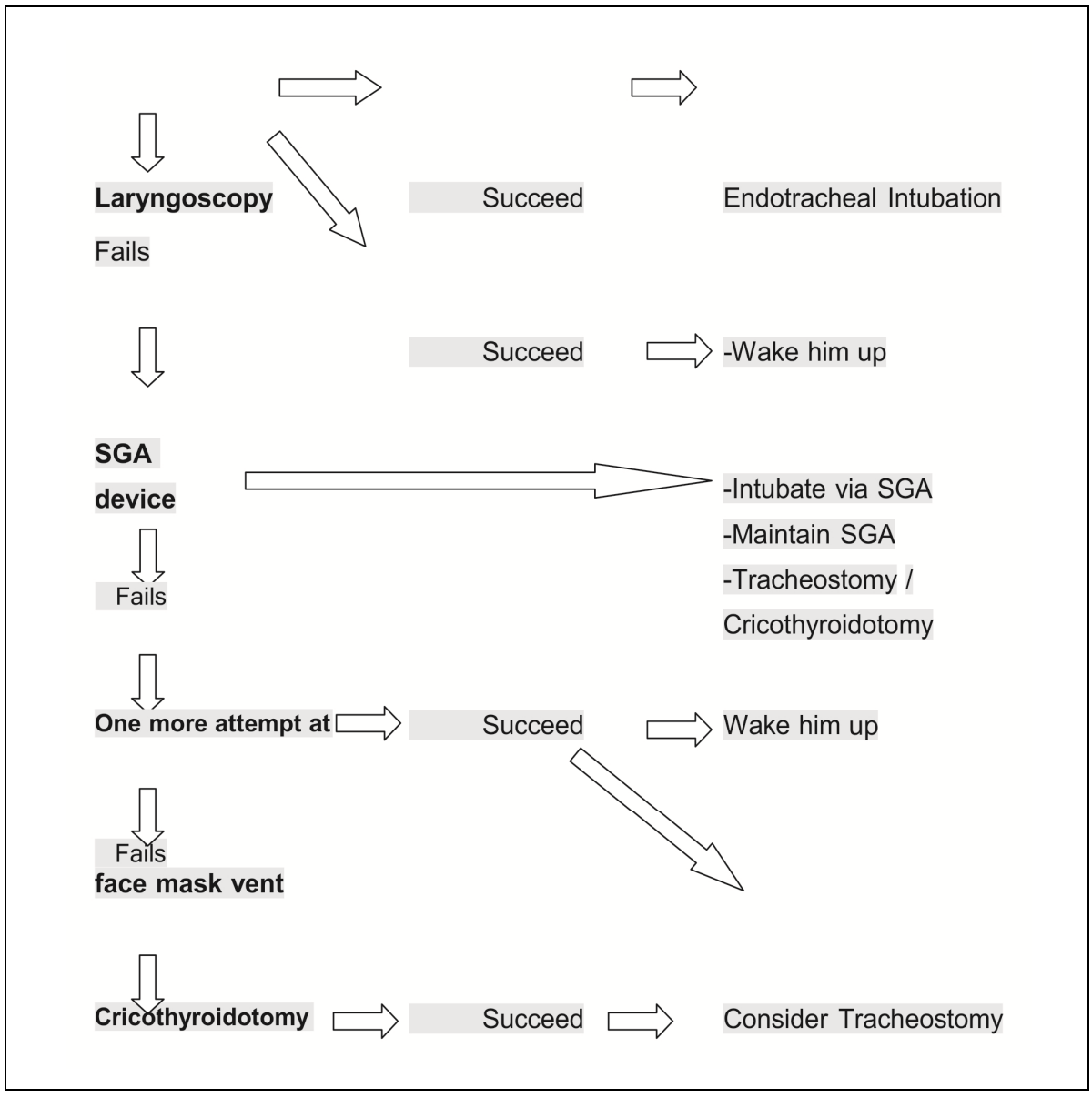
- Who has more chances of survival
- Who will give some more time for intervention
- Who will eat away‘ more time at the cost of more lives‘
- Who can be evacuated only by critical care team only & who can go by standard ambulance or a passenger vehicle with Citizen Paramedics‘
- If ETC (Early Total Care) is planned: - Intervene on day 1 (Silver Day) only if stable hemodynamically with the normal respiratory rate, temperature, urine output, coagulation profile and lactate levels.
- If DCS is contemplated, ensure that a backup basic critical care facility is available to transfer patients out by PTU / CCATT within a short time if required.

DAMAGE CONTROL RESUSCITATION

26 (a) **Effective hemorrhage control** with restricted volume replacement strategy, enough to ensure critical organ perfusion, indicated by a permissive hypotensive state of systolic BP of 70-90 mm of Hg (MAP 50-60 mm of Hg) till major bleeding due to Gun-Shot / explosives has stopped, ensures clot integrity and obviates dilutional coagulopathy, hypothermia and acidosis. However, in traumatic brain injury MAP of >80 mm of Hg is recommended. Tranexamic acid loading dose of 1gm over 10 minutes followed by maintenance infusion of 1gm over the next 8 hours is recommended whenever bleeding cannot be controlled

(b) Anesthetic considerations: Maintain a neutral position by removing only the front half of the Philadelphia collar while intubating when performing RSI. In field situations do not paralyze the patient unless ventilation with a bag and mask is possible. Avoid drugs like Propofol & Thiopentone for induction since they can cause hypotension in a bleeding patient. Hence, Ketamine and Etomidate remain the drugs of choice for induction and succinylcholine to induce muscle paralysis.

The general algorithm to be followed is



(c) Remember to secure ETT / Tracheostomy well against dislodgement during transport and watch out for drop in BP following intubation.

DAMAGE CONTROL SURGERY

27. Indicated in ongoing bleeding in a severely injured victim who is progressing to hemorrhagic shock. Damage control intervention in compressible‘ area (limbs) if ischemia is imminent may be done. e.g., to restore femoral / brachial blood flow. Similarly, one may be required to intervene in inaccessible major organ injury needing interim intervention to buy time for a definitive surgery once t h e patient stabilises.

    - Ketamine remains the main stay for induction and thereafter a volatile anesthetic agent can be used for continuation of anaesthesia.

    - Rapid sequence intubation with readiness for cardiac arrest and resuscitationis a key element.

    - **STOP THE BLEEDING**: If direct pressure for 5 minutes fails to stop rapid haemorrhage, it indicates an arterial injury or large venous rent.

    - Once the haemorrhage is under control, aim to achieve permissible normotension (systolic BP of <100 mm Hg)

    - Monitor volume status by maintaining urine output at 0.5 ml per kg body weight

    - Do not attempt extubation after DCS till 24-48 hrs / till such time the decision to conduct or not conduct a relook surgery is taken, if the patient is in a definitive care set up. If the care required is beyond the capability of the hospital, transfer in intubated state.

    - Keep patients warm by using fluid warmer‘ and forced air warming system‘

    - While carrying out evacuation, ensure a correct compliment of medics/ paramedics with emphasis on maintaining lung protective ventilatory strategy.

    - Scalp bleed is best stopped by, running and locked, vertical mattress suture guided by everting the skin edge with a haemostat.

    - In the case of open head injury with the skull fractures, the loose fracture fragments of skull should never be pushed into brain by compression and neither be removed. Place petroleum medicated gauze, with a wide dressing over it, with gentle pressure, till the patient reaches neurosurgical center in a 15° head up position.

    - In all major injuries place a self-retaining Foley’s catheter to monitor urine output once the vitals of the patient are stabilized.

    - Pelvic injuries to be managed by placing a pelvic binder/ bed sheet / large towel at the level of the greater trochanter and securing it with tight knots / pin/ stitch

    - Pain relief is important to reduce systemic response and to preserve the morale of victims. This can be achieved with Injection Paracetamol 1 gm / Injection Tramadol 100 mg / Injection Morphine 3 mg repeated 6-8 hourly. Nerve blocks are

very useful to give pain relief and must be used whenever feasible, to help reduce the requirement of opioids and other sedatives.

- Limit aims of DCS to only control bleed to save life and salvage limb. Stabilize thereafter and transfer. Defer repair of anatomical lesions. Aim to restore physiology instead.

- Amputate nonviable limb with vascular injury. Use temporary shunts for emergency vascular repair.

- Laparotomy if done, pack to stop bleed with safe application of clips and use a vessel sealing device, with no attempts to attempt ETC (Early Total Care), which should be left for the higher centre .

- Special attention is required if

    - Age greater than 70 years (higher risk due to age and co-morbidity)

    - Systolic BP less than 90mm Hg (impending shock)

    - Base deficit $\geq$ 6 (Acidosis)

    - PTT > 40 sec or INR> 1.4 (Coagulopathy)

    - GCS $\leq$ 8 (severe functional / anatomical brain compromise)

Time line to intervene

- Day 1 : Only DCS to restore physiology.

- Day 2-4 : Only a second look procedure since the body is Hyper-inflamed‘

- Day 5-10 : Definitive procedure (window of opportunity)

- Day10-20 : State of immune-suppression, no intervention

- Day 20 onwards: Secondary reconstructive surgery.

- After surgery, keep patient warm, restore volume deficit, prevent coagulopathy, give ventilatory support (if required) and monitor well.

- As a thumb rule, do not remove abdominal pack for 48 hours unless compartment syndrome sets in, or DCS was unsatisfactory and is a cause of concern due to insufficient initial control of spillage from gut or , if signs of infection set in. In such circumstances, it is prudent to re- explore under controlled settings, change packs, achieve hemostasis, decontaminate and do a feeding jejunostomy / gut diversion. A check X-ray to confirm removal of the old abdominal pack is necessary.

- Desperate‘ re-exploration in coagulopathic, acidotic unstable patient is to be attempted only in higher centers and never at mass casualty situations, where it is better to concentrate on the salvageable.

(a) **DCS for Chest Injuries**

Thoracic Injuries due to blasts and firearms needs quick interventions

- If voice is normal, any chest injury with difficulty in breathing is a candidate for needle decompression followed by chest tube insertion.

- Distended neck veins in the presence of hypotension and clear breath sounds, indicate cardiac tamponade and merits an emergency pericardiocentesis (preferably USG /FAST guided), followed by transfer to a higher center.

- Hemothorax merits tube thoracostomy. Blood >1500 ml or flow rate of > 300 ml per hour merits thoracotomy and non- anatomic stapling of lung & blood transfusion to save life.

- Open Pneumothorax needs a one-way flap seal on the wound, followed by tube thoracostomy at another site on the same side, after which the original wound may be closed by a tight suture followed by planned transfer.

- Flail chest: - Assume co existing underlying pulmonary contusion.

Control pain by non-narcotic drug or by block (inter coastal/ para vertebral) and even epidural analgesia if feasible. Signs of desaturation merits, intubation and evacuation.

(b) **DCS for Thoraco- Abdominal Injuries**

Any bullet injury below T4 (nipple level) merits evaluation for abdominal injuries.

28. **Abdominal Trauma**

(a) In a remote area or in a forward surgical center, most important decision is whether to operate or not? This is done by balancing own ability with the institutional limitations of the facility and the possibilities of a safe evacuation. The decision should be based on the appreciation of limitations of the diagnostics in the facility and, limitations of the facility for supportive care and probability to transfer a patient safely within a specified time limit to a higher center.

(b) Bullet/ penetrating injury between nipple and pubic symphysis in front and from tip of scapula to sacrum behind indicate retroperitoneal / intraperitoneal injury.

(c) FAST (Focused assessment with Sonography in Trauma) is very beneficial in the absence of which DPA (Diagnostic Peritoneal Aspiration) i.e. Four Quadrant Tap‘ should be done in field conditions and, drawl of 10 ml or more Frank‘ blood from any one quadrant constitutes indication for early laparotomy. If facility is not available, it merits transfer by the fastest means to a higher center.

(d) FAST indicating a lodged bullet outside peritoneal layer can be extracted, avoiding a full laparotomy provided DPA is negative and there is no free gas under diaphragm and hemoperitoneum is excluded.

29. **Laparotomy**

In Laparotomy for trauma, the general guidelines are: -

- Midline full incision under broad spectrum antibiotic cover.
- Pack all 4 quadrants, while searching for injuries.
- **STOP THE BLEEDING**: Clamp/ staple/ stitch on sighting the fresh bleed under direct vision.
- Reassess an unstable patient continuously and consult senior colleagues whenever possible.
- Visualize all solid organs and hollow viscus.
- Right / left medial visceral rotation, to expose retro-peritoneal injuries, to be attempted only if experienced surgeon is present and avoided as far as possible in a field condition.
- Complete surgery within 1 hour (patient is usually unstable).
- Avoid post-operative abdominal compartment syndrome, if necessary, by temporarily closing abdomen by a mesh or plastic bag (Bogota bag), and placing NG Tube and urinary catheter to reduce intra- abdominal pressure.
- Retro-peritoneal gas indicates duodenal or colonic injury and may be sutured / drained / diverted based on competence level.
- Pancreatic injury – Don‘t disturb unless bleeding actively.
- Rectal bullet injury may be associated with pelvic fracture fragments. Packing in field situation is safer. Later can undergo primary repair with a proximal loop colostomy.
- During DCS for abdominal injury the steps are:
    - control haemorrhage
    - check extent of injury
    - control contamination (resection / washing)
    - do therapeutic packing and close temporarily

30. **Liver Injuries**

Once confirmed by FAST, operate only if unstable otherwise transfer to higher center. If compelled to open as part of DCS, pack the liver, spray hemostatic fluids on the bleeding surface plus give TXA (intravenous). Transfer blood if the situation permits. Definitive surgery should be done only in higher center.

31. **Splenic Injuries**

Once confirmed by FAST, splenectomy only if there is ongoing bleed. No roleof splenic conservation in GSW injuries.

32. **Head Injuries**

Gunshot penetration may be accompanied by bleeding from multiple orifices (ear, nose, and mouth), whereas blast effect on brain may just present subtly as cognitive dysfunction, inattention, loss of concentration, delay in reaction time and imbalance of posture. The important points are

- Look for mentation and diaphoresis, presence of hypotension indicates second injury other than brain since isolated closed head injury presents as hypertension.
- Assume cervical spine injury and apply a Philadelphia type collar. Examine scalp for entry / exit wound.
- Intubate to correct hypoxia, infuse to correct hypovolemia
- Gently examine scalp for loose fracture fragments and after gently washing with saline, place sterile drape.
- Do not pack ear / nose / throat in an ongoing bleed to prevent intracranial collection of blood. Take an AP and Lateral X-ray including Cervical Spine
- Quickly conduct CASEVAC except in life-threatening EDH/SDH. Do emergency craniotomy to avoid a decorticate/ decerebrate state.
- While planning evacuation, the general principles are:
    - Unconscious – intubate and transfer thereafter.
    - Wide decompressive craniectomy, prior to transfer in desperate situations, enables survival and enables opportunity for a definitive treatment in a higher center later. Preserve the loose cranial segmentin saline/ abdominal pocket.
    - Critical care team must accompany evacuation.

33. **Pelvic injuries**:

Check for entry/exit of path of bullet and make a calculative guess.

- Make only one attempt carefully to assess mechanical stability of pelvis by compression and distraction. If unstable, apply pelvic splint.

- Watch for leg length discrepancy, scrotal / labial swelling, ecchymosis, and abrasion suggesting pelvic ring injury

- Per rectal / Genito urinary exam rules out / confirms the presence of compound fracture. X-ray (AP view) + FAST confirms blood / gas in the peritoneum.

- If blood in meatus / urine - FAST guided suprapubic cystostomy is a simple option

- Possibilities of retroperitoneal haemorrhage and coagulopathy to be kept in mind and may require transfusion of blood and blood products.

- Pelvic binder / bed sheet tied tightly at the level of trochanter /placing sandbag / bean bag at the level of trochanter / lying in lateral decubitus with injured side down & ankles tied (internally rotated femur) helps in reducing bleeding. On transfer to higher center, external pelvic fixator may be applied. In desperate uncontrolled arterial bleeding **STOP THE BLEEDING** by retroperitoneal pack with a suprapubic incision.

- On laparotomy if you see a controlled retroperitoneal hematoma, never open it. Just do a diversion colostomy if necessary.

FRACTURE AND ASSOCIATED SOFT TISSUE INJURIES

34.

- Dictum is delayed primary closure of contaminated wound

- Bullet induced open fractures in field condition should only be splinted, with a close watch for neuro vascular deficit and onset of compartment syndrome

- Blast injury induced fracture needs irrigation and debridement and application of cast / slab with a window / external fixator.

- Pain on passive extension, tense edematous limb and loss of sensation in the first webspace in foot are signs of impending compartment syndrome and merits fasciotomy.

- Mangled extremities due to ripped off‘ limbs (when at least three out of the four, amongst soft tissues, bones, nerves and vessel are damaged) with ongoing haemorrhage, merits consideration for amputation as a part of DCS & DCA

- Warm ischemia time of more than 6 hours merits consideration for amputation of limb at an appropriate level as a life saving measure.

- The guiding principle is Always save life over limbs whenever possible‘.

- Use of loupe magnification, good lighting and tourniquets helps visualize tissue better

- Whenever in doubt, excise muscles, fascia and loose bones but conserve skin.

- Since distal perfusion may be maintained by collaterals, it does not exclude major vascular injury in the limb, but gives some more time to respond. One must watch out for an expanding hematoma, which may be addressed by a temporary shunt using plastic IV tubing / drain tubes/ reversed vein graft interposed if expertise exists. Heparinize only if there is no other threat of uncontrolled bleed.

- Nerve transection should be marked by colored non absorbable suture for the benefit of easier identification by the surgeon later.

- Dressing of wounds should be done with sufficient pressure to **STOP THE BLEEDING**. However, toes and finger tips should remain exposed whenever uninjured to continuously assess the vascularity.

- Amputation: - Clinically reddish-brown urine in a dead limb 'indicates Myoglobinuria with impending ARF and weighs in favour of a decision towards amputations.

SURGICAL CONTROL OF VESSEL BLEED

35 (a) Temporary shunt should always be attempted in major vessel injuries, failing which quick ligation and control of bleed becomes necessary to save life. Advanced training to approach proximal subclavian vessel through midline sternotomy / anterolateral thoracotomy / clavicle head resection is uncommon, but if present is very valuable in a remote location where endovascular facility is unlikely to be there.

(b) To save life, the vessels which may be ligated without major deficit in aGSW & blast injury are:

(i) Vein: - External Jugular (both sides) Internal Jugular (one side), Brachiocephalic, Infrarenal IVC, left renal, Internal Iliac, subclavian, mesenteric, Tibialis anterior / Tibialis Posterior / Peroneal.

(ii) Arteries: - Digital, radial / Ulnar (one of two), external carotid, Brachial distal to profound brachii, internal iliac, profounda Femoris, hepatic artery.

LAB AND IMAGING SUPPORT AT PHC

36 (a) CBC, Serum electrolytes, Blood sugar, RFT, LFT, CPK, and blood lactate are desirable tests required to be made available. Prescreened blood and blood products are preferable, but if not feasible, fresh whole blood is to be used after testing for HIV/HBV/HCV, syphilis and malaria (preferably by card-based test) as per NACO guidelines along with blood grouping and cross matching. Temperature criteria for preservation of kits must be carefully maintained.

(b) Hand held X-ray and USG with convex sector / curvilinear transducer is a very valuable tool to detect bullet fragments / splinters, pneumothorax, hemothorax, fractures, hemoperitoneum and torn / damaged solid organs.

(c) FAST: Uses 3 to 7.5 MHz curvilinear / sector transducer. USG performed within 5 minutes of arrival in presence of overwhelming number of casualties due to bullet/

explosion/ blast injuries is extremely beneficial test to diagnose the problem of hemothorax/ pneumothorax / haemo- pneumoperitoneum in an unstable patient. The standard views to be taken are

- Longitudinal right upper quadrant - To look for fluids in perihepatic / subphrenic / Morrison‘s pouch
- Longitudinal left upper quadrant - To look for fluids in peri-splenic, splenorenal and subphrenic areas
- Suprapubic view- To look at pouch of Douglas
- Transverse Subxiphoid view- To look at Mediastinum and pleural space for haemothorax)
- Right and left lateral view – To look for fluid at right and left paracolic gutters
- General view- To detect solid organ injuries
- During ultrasound examination, assumption of Trendelenburg position helps in transfer of fluids to upper Quadrant and Anti Trendelenburg position to pelvis giving a better window for diagnosis.
- E- FAST: - Higher frequency linear transducer used with dual probe of 3 - 3.5 Hz and 7-12 MHz are now available in the market and used to diagnose Pneumothorax better by detecting
  - Absent pleural sliding
  - A line more numerous than normal and placed unevenly
  - Absence of B lines
  - Signs on M- mode ultrasound barcode or stratosphere sign.

- IVC diameter evaluation to access hypovolemia: Using subxiphoid approach with transducer in sagittal orientation, IVC diameter 2cms below Cavo Atrial junction is measured. IVC collapsibility >12 to 15% indicates volume depletion levels and indicates requirement to step up fluid / blood.
- Solid organ injury: - Look for
  - Subcapsular collection in Liver / Spleen
  - Heterogeneous appearance of liver / spleen parenchyma – indicates Bleed / injury/ damage
  - Echogenic area within in liver / spleen parenchyma suggests laceration.

MEDICO-LEGAL ASPECT

- GSW/ Blast injuries in a combat scenario are treated with implied consent‘ for emergency care in combat zone. However, legally valid consent is important for elective interventions.

- Identification of death in warzone should be carefully done ethically and morally.

- Even a bullet injury patient has legal right to autonomy and self- determination enshrined within Article 21 of Indian Constitution and can refuse a treatment unless the intervention is labeled emergency.

- Informed refusal also forms an important part of informed concerned and a patient may choose for intervention only in a higher center. Hence, legally valid consent is important. However, in a tactical combat scenario only implied consent is sufficient provided imminent threat to life or limb exists.

- When GSW injury / explosive blast injury gives you some time for second opinion, it may be taken if required.

- Death in combat zone/terrorist operations/civilian life merits clinical autopsy / Medico-legal autopsy after clearance by military/ police / UN observers and records of it are required to be kept in safe custody

- Victim of bullet injury may wish to make a dying declaration. In such circumstances, magistrate of the enemy country is intimated and when he is unable to come, the MO may record the Dying declaration‘ after certifying the soundness of mind in presence of 2 witnesses whose signature are affixed in the document. A video of the dying declaration may be recorded if in a hospital.

- Personal effects of the victim should be disposed correctly.

- Radiographs, Fingerprints, and basic dental data must be recorded and matched to establish identity.

- In war injuries, the international code of medical ethics, laws of armed conflict and the international convention on human rights (Geneva Convention) should be followed and matters of conflicting loyalty addressed.

RECOMMENDATIONS

The key recommendation of the white paper is as given below:
Policy formulations, facility improvement training, education and awareness programme on medical aspects should be targeted

1. **To address the issues related to lack of data about Gun-shot & Blast Injuries:**

   Problem: How many cases of Gun shot injury or Blast injuries are treated in civil as well as in armed forces hospitals in a year? No data is available since there is no Trauma registry/Gun shot registry/Blast injury registry.

Recommendations: Eminent institutes may be entrusted with the responsibility with establishment of a well funded, well staffed independent department. There is a need to develop countrywide Trauma registries to know the exact number of Gun shot injuries and blast injuries, age group, occupation, gender, causes, circumstances, nature of firearm/explosives used, part of the body affected, high risk areas, high risk groups and so on. Only then the pattern and likelihood will become apparent.

2. **To address the issue of insufficient knowledge amongst citizenry about the 'First response' to Gunshot & Blast injuries**

Problem: Action taken within the first 30 minutes to stop bleeding and maintain respiration usually decides whether the victim will live or not. However, most of the victims do not reach the nearest trauma centers within this time. Often patients are taken by bystanders/ good Samaritans without any measures to stop the bleed or secure airway due to lack of knowledge about how to do it. Every year a large number of precious lives are lost unnecessarily.

Recommendation: All children from school level is taught how to stop bleeding from a wound, and how to give CPR by periodic practice of First Aid from class VIII onwards, teaching them the basics of Life Support (BLS) in class VIII and IX, and making BTLS a compulsory part of Class Xth exam. This could be easily performed by unskilled and untrained citizenry easily in a trial setting. Hence all citizens of India should know this and should not be left to medics and paramedics to whom a victim does not reach soon enough

3. **To address the issues related to quality of Patient management**:

Problem: There is no fixed protocol followed in managing the patient of gunshot wound or blast injury patients in majority of hospitals. In most of the tertiary care level hospitals in civil setup super-specialists work on contract, and are hence available only on call. In many of the hospitals patients are being managed according to system in vogue locally. The surgeon managing thoracic injury may not be comfortable in managing abdominal injury or vascular injury. There is scarcity of trained and experienced surgeons who are capable of analyzing the patient as a whole and who can understand the deranged physiology of the patient due to simultaneous injury to the multiple anatomical regions of the body, be it thoracic, abdominal, vascular injury or head injury and take a quick decision when to operate and when not to operate.

Recommendation: We need to shift patient management from system based to holistic approach by ensuring that all diploma holders, graduates, postgraduates and post-doctoral medics and paramedics must be trained in BTLS and ATLS which needs to be incorporated as part of their educational qualification and validated by an independent agency. Once in a hospital, the trauma management should be based on an established protocol and checklists, which when followed should provide reasonable protection from litigations. Further all surgeons (including superspecialists) must be required to conduct a minimum of 10 life / limb surgeries in a trauma center every 2 years as part of the process for renewal of license to practice. The specific issues pertaining to educational standards, certification, continuing education and evaluation requirements for doctors involved in trauma care are yet to be fully addressed and time has come for a

high-powered team of experts cum policy makers to deliberate on it and evolve a National Policy on the matter linked to license to practice.

4. **To address the issues related to lack of Rehabilitative services**

Problem: There is a lack of knowledge on the socio-psychological impact of gunshot injury and blast injury on the survivor and their families. PTSD (Post traumatic stress disorder) is characterized as failure to recover after experiencing a terrifying event. This brings back memories of the trauma accompanied by intense emotional (flashbacks) and physical (pain, trembling) reaction due to heightened reactivity to stimuli, anxiety or depressed mood and has a long-term impact on the psyche of the victim. They need expert counseling but are currently counseled by amateurs in the field.

Recommendation: The apex medical institutes must initiate focused research in the field and train a subset of psychiatrists and Clinical Psychologists in the field of PTSD. GoI may consider establishment of Rehabilitation Centers focused on the rehabilitation of the Trauma Victims with a wide mandate to interact with intergovernmental agencies.

5. **To address the issue of financial compensation for the trauma care providers**

Problem: Trauma victim on many occasions reaches the emergency department as unknown‘ and hence not in a position to pay for the services on arrival. However, the hospital is required to commit his resources immediately

Recommendations: Government has to come out with a policy of financial compensation for all trauma victims. This is because they constitute the largest share of preventable death all over the world and in a young earning population out on the road for work and leisure, thereby contributing to the nation‘s economy. Unless this issue is addressed, victims of critical firearm injuries in civilian life will continue to die by and large.

6. **To aim for a modern, well equipped, well networked ambulance service manned by ATLS trained staff in all parts of India.**

Problem: Most state governments and Municipalities in the last 10 years have made a substantial progress in developing their Ambulance services e.g., 108 Ambulance‘ which are integrated with call centres and work 24 X 7 X 365 days, and this service is slowly progressing towards even Tier 2 towns, which is very encouraging. However, we have a long way to go as a nation to make these ambulances capable of handling Blast and GSW injuries. As of now these ambulances can by and large give oxygen and fluids and have facilities to give a CPR.

Recommendations: Most of the ambulance services are not geared up to treat bullet / blast injuries. The emergency ambulance services are required to be fully equipped with a certified staff proficient in BLS and ATCN / ATLS. Similarly, the ambulances are required to be equipped with trauma care products like tourniquet, haemostatic dressing, resuscitatory equipments, needle thoracostomy, tube thoracostomy, spine stabilizers, volume expanders, modern splints, along with AI based interactive help modules and GPS enabled patient friendly modern vehicle.

7. **To aim for introduction of robust training in trauma care as part of the Medical, Nursing and paramedical curriculum.**

Problem: Medical, Nursing or Paramedical curriculum does not have any structured training in Trauma care. Hence the ability of doctors, nurses and paramedics to manage bullet injuries is in general inadequate.

Recommendations: Basic management of bullet/ blast injury should becomea compulsory element of all certificate programme, degree and diploma in the field of medicine, paramedical and nursing education with regular mandatory refresher training to maintain currency (online or offline or both in combination). ATLS for doctors and ATCN for Nurses and paramedics should become compulsory part of license to practice.

8. **All out efforts to be made to reduce the availability of illegal firearms**

Problem: Illegal manufacture of weapons, possession of illegal weapons as well as illegal usage of legal weapons is common in India instilling fear and hesitancy in the mind of general public. Whenever citizen is forced to hold himself from his honest contribution towards his nation, due to fear of certain elements of the society and those working covertly to weaken a nation‘s will, that nation can never rise to its true potential. All policy makers must give very high importance to this matter and address it.

Recommendations: All round efforts should be made to reduce availability of illegal firearms. License should only be given only when one has attained the age of 25 provided one clears a well organised psychological test assessed by an experienced psychologist and can provide a valid reason for its requirement, which should be mandatory prerequisite in even applying for license for firearms with legal provision to monitor the owner‘s conduct in a continuum.

9. **All trauma centres should be well staffed with competent medics**

Problem: Trauma centres should be managed by doctors, nurses and paramedics of special competence in the field of trauma. This has been largely diluted in most canters due to non-availability of adequate number of fully qualified certified staff.

Recommendations: Formal education and specialty training in emergency medicine, trauma surgery, and critical care are desirable (but not mandatory) attributes for personnel involved in trauma care, but is a mandatory requirement to expertly handle disruption of the body due to bullet / explosive since it involves a different dimension of anatomical and physiological avalanche where time is in premium i.e., quality of intervention in the platinum 10 – 30 min decides the fate of 50% of victims. However, such training is not available at most of the Medical / Paramedical training institutes. This needs to be addressed by use of advanced trauma simulators in training, combined with one year internship in higher level centre.

10. **Records held by all stakeholders in the crime management must be integrated in a common database**

Problem: In India, various stakeholders concerned with bullet and blast injuries which constitute the maximum mode of crime are not integrated.

Recommendations: It is suggested that all Police Stations, Medical Colleges and District Hospitals where medico-legal post mortem is held and the associated Forensic lab as well as the criminal courts needs to be integrated and a centralized data base formed so that accurate, valid and reliable data can be recorded. This may be considered a very critical repository of database. All planning and policies can be made accurately if the integration is done properly.

EXECUTIVE SUMMARY

War is the most expensive event in the life of a nation. Terrorism has the most devastating impact in the psyche of a nation. Crime and violence have the maximum impact on the social fabric of a nation. Collectively these lead to inability of a nation to rise to its true potential. The reason for the above is that no other event destroys the life and property of a nation as is done by war, terrorism and crime. A rising aspirational nation like India must take note of this and develop capabilities to minimise its impact by dovetailing its policies on management of injuries due to firearm and explosives with the current capabilities in the field of medicine which is currently focused on treatment of diseases. Unlike diseases which can be effectively prevented, injuries due to firearms cannot be predicted and hence cannot be effectively prevented. However, the burden of its medical, physical, mental and economic impact can be minimised by effective interventions.

The pattern of firearms has changed in the last few decades from single shot weapons used 100 yrs back to self loading automatic carbines used for past 50 years to current gas operated magazine fed assault rifles which are fast replacing the carbines. Similarly, apart from the potential explosives being used in domestic life like LPG, the explosives used by the industries as well as terrorists are acquiring increasing lethality with development of newer chemicals like RDX, and azidoazide azide. Their use as remote controlled explosives provides an ability to cause devastating injuries with unprecedented capability to mutilate and disrupt body parts. These issues need to be objectively addressed. Similarly, the real and large-scale threats to military as well as civilian strategic targets being hit by drones and Quadru / Hexi / Octa / Multi / Hybrid copters should never be underestimated reaffirming the need for a robust workable competence-based region wise chain of trauma care echelon.

Similarly addressing the deficiencies in the abilities of the primary, secondary and tertiary medical care setup limiting provision of comprehensive trauma care, the inadequacies of ambulance services, gaps in training, record keeping, need for creating a national registry for trauma, and creating a mobile app based interactive trauma teaching, training and response network using available disruptive and futuristic technologies freely available to all citizens of India will go a long way to reduce mortality due to firearm injuries .The need to ensure compliance to firearm regulations and enforcement of punitive measures for violation is a must to reduce violence in society.

The Medical Colleges and hospitals and Level I, II and III Trauma Centre should be able to provide the highest level of definitive and comprehensive care for patient with complex

injuries. This will require a sustained effort toward development of competency at all levels and financial commitment by the government. The importance of learning Basic Life Support, Basic Trauma Life Support for the common man and Advanced Trauma Life Support for Nurses, Paramedics and Doctors should be recognized and ATLS /ATCN courses should become a mandatory requirement for license to do clinical practice.

All citizens must be equipped with two specific abilities i.e., how to stop bleeding, and how to give cardiopulmonary resuscitation at the point of injury. Primary trauma care must be accessible by the injured within the golden hour by the fastest means. Once the victim reaches the hospital, a non-coercive ecosystem should be put in place whereby he is attended to immediately without any financial or legal hurdles for the attending doctor and his/her team. India should be able to improve their trauma care systems using affordable and sustainable programme, identifying problems especially related to system issues, developing reasonable corrective action plans, following through on implementing these plans and evaluating whether the corrective action plan has had its intended consequences.

Trauma care needs to change in favor of honest taxpaying citizens who should by a conscious government policy automatically be insured for long term treatment. Similarly emergency care for BPL families be adequately covered under the Ayushman Bharat scheme. Development of high quality and innovative home-grown technology with innovative low cost, more durable, and easier to repair versions of many medical device will play a big role in making the trauma care affordable for the middle and lower sections of the society and in the villages and the hinterland.

The content and context in this white paper is relevant to current Indian scenario and its projection in the next 10 years by which time India is expected to become a firmly established world power with the ability to hold on its own. For that to happen the spread and reach of trauma care across the country in general and enhanced ability to treat injuries due to firearm and explosives specifically, must be achieved.

Experts from the Armed Forces Medical Services (AFMS) and National Academy of Medical Sciences (NAMS) have collaborated to develop this white paper on **Gun-shot & Blast Injuries** for submission to the Government of India. Implementation of the recommendations has the potential to transform the paradigm of management of firearm and explosive induced injuries in our country.

References

1. Khan I, Shakeel M, Usmani JA, Hasan SA. Emerging Trends of Intentional Firearm Injuries in Northern India: A Study. J Clin Diagn Res. 2016;10:HC01-HC04. doi:10.7860/JCDR/2016/23392.8760.

2. Malik, Fazle Rab et al. ¯Evaluation of complete profile and outcome of gunshot injuries in tertiary care centre. International Surgery Journal (2019): n. pag.) DOI:10.18203/2349-2902.isj20190042

3. Roy, N., Murlidhar, V., Chowdhury, R., Patil, S., Supe, P., Vaishnav, P., & Vatkar, A Where There Are No Emergency Medical Services—Prehospital Care for the Injured in Mumbai, India. Prehospital and Disaster Medicine.2010; 25:45-151. doi:10.1017/ S1049023X0000788

4. Emergency and Injury Care at District Hospitals in India: A Report of Current Status on Country Level Assessment. A study conducted by Department of Emergency Medicine, JPNATC, AIIMS. 2020

5. Tiwary B, Nilima N, Majumdar P, Singh M, Khan MA. Quality of services provided by public funded ambulance program: Experience from a northern state in India. CEGH. 2020;8:962-966. DOI:https://doi.org/10.1016/j.cegh.2020.03.005

6. Joshipura MK. Trauma care in India: current scenario. World J Surg. 2008 Aug;32(8):1613-7. doi: 10.1007/s00268-008-9634-5

7. Sharma M, Brandler ES. Emergency medical services in India: the present and future. Prehosp Disaster Med. 2014;29:307-10. doi: 10.1017/S1049023X14000296. Epub 2014 Apr 10. PMID: 24721137.

8. Malhotra R , Mizobata Y. Trauma Care in India and Japan: Current Situation and Future Prospects. ERIA Research Project Report 2021.

9. Gambhir RPS, Agrawal A. Training in Trauma Management. MJAFI 2010; 66 : 354-356.

10. Dharap S. Trauma and General Surgeon. *Indian J Surg*. 2020; 82:121–123 https://doi.org/10.1007/s12262-020-02103-3.

11. Kumar, S. Trauma and Emergency Surgery—a Career with Passion. *Indian J Surg.* 2021;p (Suppl 1), 1–2. https://doi.org/10.1007/s12262-021-02940-w

12. Bhat R. Regulating the private health care sector: the case of the Indian Consumer Protection Act. *Health Policy Plan*. 1996;11(3):265-279. doi:10.1093/heapol/11.3.265

13. https://www.deccanherald.com/india/a-guide-to-indias-stringent-gun-laws-1102061.html

14. Bhandarwar AH, Bakhshi GD, Tayade MB, Borisa AD, Thadeshwar NR, Gandhi SS. Surgical response to the 2008 Mumbai terror attack. Br J Surg. 2012 Mar;99(3):368-72. doi: 10.1002/bjs.7738

15. Shah MT, Joshipura M, Singleton J, LaBarre P, Desai H, Sharma E, Mock C. Assessment of the availability of technology for trauma care in India. World J Surg. 2015 Feb;39:363-72. doi: 10.1007/s00268-014-2805-7

16. Sukumar GM, Ghosh S, Gururaj G. Trauma care systems in healthcare facilities of an Indian District: Assessment and future directions. J Family Med Prim Care. 2023;12:567-575. doi: 10.4103/jfmpc.jfmpc_1861_22

17. Roy, N., Kizhakke Veetil, D., Khajanchi, M.U. et al. Learning from 2523 trauma deaths in India- opportunities to prevent in-hospital deaths. BMC Health Serv Res. 2017;17:142. https://doi.org/10.1186/s12913-017-2085-7.

18. https://main.mohfw.gov.in/sites/default/files/Prog%20brief%20Trauma%20component%20.pd (accessed on 03 Aug 2023)

19. https://timesofindia.indiatimes.com/city/mumbai/trauma-care-centres-in-maharashtra-deficient-cag/articleshow/60022093.cms (accessed on 03 Aug 2023)

20. Guidelines for trauma quality improvement programmes (2009). World Health Organization, International Society of Surgery, International Association for the Surgery of Trauma and Surgical Intensive Care, editors. https://iris.who.int/bitstream/handle/10665/ 44061/ 9789241597746 _eng.pdf?seq uenc e=1

21. https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1919984

22. https://www.files.ethz.ch/isn/143581/IAVA-IB2-mapping-murder.pdf