Needs List for Emergency and Trauma

I.

Need Statement:

A definitive way to **prevent foot ulcers** that can develop into sepsis, gangrene, cellulitis, necrotizing fascitis leading to foot amputations in patients with **diabetic neuropathy.**

Brief Description of the Need:

Patients with Diabetes for more than 4-5 years develop a condition called as Diabetic Neuropathy (decreased sensation due to dying nerves over the feet and hands). Due to this, patients lose the ability to feel pain or discomfort due to increasing pressure or injury over their feet. Additionally, due to the dying nerves at the feet, the blood vessels supplying the sole also become narrow and brittle. So now there are very few healthy blood vessels or nerves at the sole of the feet. Any injury thus does not heal on its own nor does any medication reach the site of injury adequately. Patients develop serious infections that travel rapidly, and on many occasions require an amputation of the affected limb to prevent spread of disease.

Treatment Gap Today:

Patients are asked to wear protective shoes/soles to prevent any foot injury. Even a small injury either external or due to pressure does not heal easily. In Indian societies it is impractical to wear shoes 24 hours a day. Many patients even though are aware of this, develop injuries while going to the toilet or while visiting temples etc. Women do not prefer wearing shoes for long periods of time for various reasons.

Solution Guidance (Suggestion):

The compliance to wearing footwear is low due to individual preferences. However, the patient realizes the importance of such care only after an injury occurs. The solution therefore must not be dependent on patients' compliance. Rather, it must be something therapeutic—administered by the doctor that prevents foot injury for few months to years. This is similar to the model followed by cardiologist's coronary vessel stents to prevent myocardial infarction in high-risk patients even though myocardial infarctions (MI) can be prevented by various life style modifications.

II.

Need Statement:

A way to **temporarily manage Traumatic Brain Injury** in patients in the Emergency Department who are not able to access definitive neurosurgical management (due to lack of ICU beds, availability surgery etc.) in order to prevent coning of the brain stem, herniation and subsequent respiratory arrest/ death.

Brief Description of the Need:

Patients with head injury, usually following a road traffic accident, develop a rise in Intracranial Pressure (ICP). This rise in pressure is due to swelling within the brain tissue or internal bleeding. This rising pressure after a point pushes the brain stem downwards into an opening in the lower part of the skull called the foramen magnum. This phenomenon is called "coning" and this compresses the respiratory centers in the brain stem and leads to respiratory arrest and death. An immediate neurosurgical intervention is required to drill a hole in the skull and release the pressure. Patients require ICU care after the procedure. So, many times if the ICUs are full or neurosurgeons are not immediately available, there is nothing that can be done at the emergency room to prevent the coning of the brain.

Treatment Gap Today:

Some fluid medications like Mannitol reduce the intracranial pressure temporarily but their effect is usually sub optimal in larger head injuries and their effects last only for a couple of hours. Lumbar puncture to remove CSF fluid is contraindicative today as the sudden release in pressure also precipitates coning. CO2 gas inhalation also temporarily reduces ICP but it cannot be provided for more than one or two hours.

Solution Guidance (Suggestion):

A solution that an emergency and trauma doctor can use on the patient to monitor rising intracranial pressure and manage it temporarily for 8 - 12 hours, so that there is enough time to wait for neurosurgical intervention or to be transferred to another center where a definitive intervention can be performed.

III.

Need Statement:

A faster way to accurately **detect the rising intracompartmental pressure in the musculoskeletal compartment** due to soft tissue injuries at the Emergency Department in order to prevent an impending compartmental syndrome and nerve injury.

Brief Description of the Need:

Patients with a crush injury to their limbs either due to a road traffic accident or a fracture due to a fall have a high risk of developing a rising intra compartment pressure within the forearm. This can be due to the swelling, bleeding or fluids released due to the injury and this raises the pressure within the sheathed compartments present within the forearm. This rising pressure presses on the nerves that supply the hand. If this pressure is not relieved early then these nerves can get damaged. Sometimes the damage is temporary and sometimes it could be permanent—based on severity of injury or delay of definitive care, which is releasing the pressure by nicking the enclosing sheath (Fasciotomy).

Treatment Gap Today:

The only way to detect rising intracompartment pressure is by assessing the clinical symptoms. By this time the process of nerve injury has already begun. If the patient has a cast for fracture management then clinical examination may be difficult and patient presents only when in severe pain. If immediate fasciotomy is not performed it can cause significant damage. There is no readily available solution that can monitor in high-risk patients a rising intracompartment pressure that can guide the management to release the pressure.

Solution Guidance (Suggestion):

A solution that an emergency and trauma doctor can use to monitor and immediately evacuate rising intracompartment pressure so that the time to administer definitive care is reduced. This will help save the nerves from ongoing damage due to rising intracompartment pressure.

IV.

Need Statement:

A quicker way to accurately **perform endotracheal intubation** in a patient who falls under the category of **difficult intubation** (cervical spine injury, facial fractures, facial edema, or short neck) in the Emergency Department.

Brief Description of the Need:

Endotracheal intubation is a life saving procedure to secure the airway in patients who have a compromised airway due to a wide variety of reasons ranging from head & neck injury to cardiac emergencies to infectious diseases. The extension of the neck is a very critical step that facilitates a safe and quick insertion of the tube. In some patients, it is not possible to extend the neck and in these situations it is not easy to insert a standard endotracheal tube. This leads to multiple attempts with injuries around the airway and delay in securing the airway, which worsens the patient's condition and leads to delay in this life saving procedure.

Treatment Gap Today:

A standard endotracheal tube available today is not easy to introduce if adequate neck extension is not present. Videolaryngoscopy is used sometimes to see whether the tube is being inserted while not giving extension. But this requires a lot of skill too since the videolaryngoscope itself requires some amount of neck extension to visualize the larynx. Flexible tubes that do not require extension are not easily available.

Solution Guidance (Suggestion):

The solution should enable easy introduction without neck extension while using existing endotracheal tubes. Since an emergency intubation in a patient who falls under the category of difficult intubation requires immediate action, a separate tube if needs to be arranged at that point may lead to further delay in management.

V.

Need Statement:

A definitive way to **immobilize the spine in patients** with suspected spinal injury during transportation.

Brief Description of the Need:

Patients with spinal injuries are required to remain immobilized in order to avoid further damage to the important nerves that are housed within the vertebral column. Spinal injury is typically seen after fall from heights, whiplash injuries while travelling in a moving vehicle or in high collision accidents. Transporting the patient from the site of injury to a hospital setting requires the maintenance of this immobilization in order to prevent significant damage to the spinal nerves and resulting paralysis from the same.

Treatment Gap Today:

Spine boards are available to immobilize the spine, but in many occasions the process of placing a patient on the spine board itself requires spine immobilization. Even after the patient is on the spine board, robust securing of the patient to the board is necessary. Spine damage can occur if the patient is on the spine board but is not well secured during transport. This problem is seen very frequently when patients are taken in for CT scans and X Rays.

Solution Guidance (Suggestion):

A solution that supports the spine at the site of the injury or when first applied; and immobilizes the spine effectively even though the patient is being transported through the healthcare system.

VI.

Need Statement:

A definitive way to **immobilize peripheral limbs in patients** with fractures caused by trauma (road traffic accidents, falls etc.) in order to prevent complications resulting from mismanagement of the injury (nerve injury, blood vessel injury, malunion of the fracture, fat embolism)

Brief Description of the Need:

It is important to maintain immobilization in fractures of long limbs while transporting the patient from the site of injury to the hospital, and during internal evaluations such as radiology tests and reduction methodologies, to prevent injury to blood vessels and nearby nerves. Faulty splinting or cast applications to reduce fractures can lead to improper healing and permanent deformity (malunion, aunion of fractures) that may require surgical correction. In some cases, excessive movement in long limb fractures can displace the fat within the bone marrow into blood vessels that can block the supply to the lungs causing pulmonary fat embolism. Hence, the need for a robust immobilization mechanism right from the site of injury till the end of the management.

Treatment Gap Today:

On the site of injury bystanders use wooden sticks, rulers/ scales, or similar ad-hoc solutions. In the hospital, doctors use plaster-of-paris to create splints and casts. However, once the casts are applied, the movement within goes unmonitored. Often, the applications of these solutions require movement and manipulation of the limb. For example, the Thomas splint application in the leg requires lifting the leg all the way upto the hip joint.

Solution Guidance (Suggestion):

A solution that can be applied immediately to stabilize the affected limb from the site of injury and can be removed or reapplied without moving or manipulating the limbs. Further, it should be radiolucent to enable x-ray imaging.