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SPECIAL REPORT

MEETING THE CHALLENGES OF SPINAL CORD INJURY CARE FOLLOWING SUDDEN ONSET DISASTER – LESSONS LEARNED

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Improved disaster response has led to higher survival rates and an increasing number of injuries in relation to deaths (injury to death ratio). Recent earthquakes, in particular, have led to unprecedented numbers of spinal cord injuries. Meeting the needs of individuals with spinal cord injuries is particularly challenging when disaster strikes a low resource environment. Clinicians who care for spinal cord injuries can learn from prior experiences and proactively address how to best meet needs in future disasters. Here we review and propose measures targeted to specific challenges including: coordination and mobilization; identification and procurement of required expertise; initial survey and assessment; health care delivery; community reintegration and health maintenance; and sustainability and capacity building.

Key words: spinal cord injuries; quadriplegia; paraplegia; rehabilitation; disasters; disaster planning; earthquakes.

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INTRODUCTION

It is a certainty that future disasters will occur. Improved disaster response has led to an increase in survivors with injuries and major impairments; correspondingly, injury to death ratios have increased over the last 40 years (1). Earthquakes in particular lead to many individuals sustaining spinal cord injury (SCI) – more than 200 SCIs following the December 26, 2003 earthquake in Bam, Iran (2); an estimated 650–750 SCIs after the October 8, 2005 earthquake in Kashmir, Pakistan (3); and approximately 150 survivors of SCIs resulting from the January 12, 2010 earthquake centered southwest of Port-au-Prince, Haiti (4). The Pakistan earthquake had the highest number of SCIs ever reported following a natural disaster (5). Natural disasters also impact those who have previously sustained SCIs. Typhoon Ketsana, which struck central Vietnam on September 29, 2009, affected an estimated 100 individuals with SCI (Weerts E., Project Coordinator/Technical Advisor SCI Program Handicap International Vietnam, Personal communication, 2011). Home modifications were required to restore accessibility and facilitate activities of daily living, familial agricultural income was disrupted, and many individuals were readmitted to a provincial SCI unit at Da Nang.

A region's ability to respond to the needs of individuals with SCI varies considerably. Even resource rich countries can be overwhelmed following a disaster, as evidenced by the following testimony related to Hurricane Katrina in the United States.

"*On the morning of August 29th, I received a call that I will never forget, and once I tell you about it, I hope you will never forget it either. My friend and colleague, former appointee to the Social Security Administration, Susan Daniels, called me to enlist my help because her sister-in-law, Benilda Caixetta, a New Orleans resident who was quadriplegic, paralyzed from the shoulders down, had been unsuccessfully trying to evacuate to the Superdome for two days. Despite repeated requests to be evacuated, in her power wheelchair, which is a vital tool for mobility and independence, the paratransit system that serves the transportation needs of people with disabilities never showed up. In my naiveté I thought a few phone calls to the 'right' people would help, and I was sure I knew who to call. I was wrong. After many calls to the 'right' people, it was clear that Benny was NOT being evacuated. I stayed on the phone with Benny for most of the day, assuring her that I was doing all I could to make sure help would be coming as soon as possible. I was on the phone with her that afternoon when she told me, with panic in her voice, 'the water is rushing in' and then her phone went dead. We learned 5 days later that she had been found in her apartment, dead, floating next to her wheelchair.*"

(Note. Statement of Marcie Roth, Testimony Before the Subcommittee on Oversight, House Committee on Ways and Means, December 13, 2005 (6).)

Given disasters will continue to occur, organizations with SCI expertise should proactively plan for the next event. SCI medicine practitioners can learn from recent experiences in order to identify, develop and operationalize appropriate interventions for future disasters. Here we 1) discuss challenges associated with SCI in the context of a disaster, and 2) outline how the international community can contribute to the care and well-being of individuals impacted by such events.

Coordination and mobilization

Identified challenges. In the aftermath of a disaster, first responders are typically from the affected country or region. Foreign responders can rapidly follow, depending on access to the country. Responding organizations include government bodies, multinational agencies such as the United Nations (UN) and World Health Organization (WHO), military personnel, non-governmental organizations (NGOs), and private entities with resources (e.g., corporations, hospitals, affluent individuals). The local government is often overwhelmed, as we observed in Haiti. In this setting, there is no clear entity to oversee the deployment of responders. Unannounced arrivals of well-intentioned assistance further complicate the matter.

In the ensuing confusion, it is a challenge to achieve effective inter-organization coordination and deploy available resources and expertise in an efficient manner (7). Ineffective coordination also compromises extrication and transportation of injured individuals. Following the May 12, 2008 8.0 magnitude earthquake in the Sichuan region of China, the mean extrication time for spinal injuries trapped under rubble was 12.2 h (8); however, lapses in coordination contributed to lags between initial extrication and appropriate medical evaluation. As a result, the mean time to hospital referral (3.6 days) was significantly longer than the time required for initial rescue (12.2 h) (8).

Possible solutions. Coordination involves two phases: pre- and post-deployment (9). A proposed framework to guide coordination is 'consultation-coordination-integration' (9). Pre-deployment issues (e.g., local security, transportation, and lodging) must be considered, and the affected region consulted prior to deployment. Responders need to be aware of their anticipated role, and preferably have some disaster training. Once needs become apparent, activities should be coordinated through national officials and integrated within existing health systems. When this is not possible due to breakdowns in government, responding teams must be receptive to working with alternative coordinating bodies, such as the WHO Global Health Cluster (GHC). The GHC is comprised of more than 30 international humanitarian health organizations that work together to build partnerships and develop common approaches to humanitarian health action.

Local mechanisms to enhance coordination and communication should also be encouraged. In Haiti, a coalition was formed of providers involved in the care of individuals with SCI (authors observation). The coalition facilitates communication and aides in patient care and resource management, and collaborates with the coordinating Health Cluster. Now referred to as the Haiti SCI Group, it is the primary mechanism for coordinating SCI care in the country. Periodic face-to-face meetings are held to discuss shared problems and accompanying solutions as well as engage in advocacy and training initiatives.

Military-civilian collaboration is also vital (10, 11). In some circumstances, large scale response efforts are only possible with military involvement. In the initial days after the earthquake in Haiti, the US military provided security and maintained order, supplied critical equipment and supplies, transported patients, and participated in direct patient care (12). The 500 bed U.S. navy hospital ship Comfort cared for many individuals with SCI. After the 2005 Pakistan earthquake, military facilities such as the Armed Forces Institute of Rehabilitation Medicine (AFIRM) in Rawalpindi played a prominent role in the management and rehabilitation of SCI patients (12).

Identifying and procuring required expertise

Identified challenges. Prior to the 2010 earthquake, there was little capacity to care for SCI in Haiti and few individuals survived long-term following a severe SCI (4). In such situations, the required expertise often does not exist in the impacted environment. Instead, experts need to be quickly identified and deployed. Identifying appropriate individuals is crucial to ensure good outcomes. In the aftermath of the 2005 Pakistan earthquake, individuals operated on by surgeons without spine expertise are experiencing greater rates of implant failure, wound infections and pain at the operative site (13). In Pakistan centers unsupervised by rehabilitation specialists, there has also been an increased incidence of urethroscrotal fistulae associated with clean intermittent catheterization (3), which has been attributed to poor technique.

Possible solutions. Expatriates can play a particularly important role, due to increased familiarity with language and local customs. In Pakistan, expatriates from the UK and US provided valuable expertise and served as liaisons between Pakistani and foreign resources (12). When possible, the aid of organizations with pre-existing involvement in the impacted area should be enlisted. Healing Hands for Haiti (HHH) and Team Canada Healing Hands played major roles following the 2010 Haiti earthquake (authors experience), as did Handicap International Vietnam following Typhoon Ketsana in 2009.

The identification and mobilization of expertise can be facilitated by the development of international volunteer databases. Databases would include individuals who have expressed a willingness to participate in disaster response efforts. Expectations and responsibilities should be made clear, and consideration given to drafting Terms of Reference for volunteers. The pro-active organization of an expert database would allow proper vetting and credentialing, and facilitate disaster training. The importance of credentialing foreign medical teams (FMTs) is increasingly recognized, as highlighted by the unanimous support of such a concept at a WHO/Pan American Health Organization (PAHO) guided consultation on FMTs (Havana, Cuba December 7–9, 2010) (9). Cost effective training opportunities (e.g., webinars) can be provided to maximize competency and preparedness of database participants. The American Medical Association (AMA) conducted a webinar specific to the Haiti earthquake within days of the event.

Currently no standing database exists for SCI. Professional societies, such as the International Spinal Cord Society (ISCOS) and American Spinal Injury Association (ASIA), can play a vital and invaluable role by facilitating the develop-

ment of a volunteer database. International organizations (e.g., WHO, International Federation of Red Cross and Red Crescent Societies (IFRC)) could then be informed of the database and its utility as a resource. Existing databases can be emulated. The UK developed an International Emergency Trauma Register (www.uk-med.org). Members are available at 24–48 h notice to be deployed overseas for 2–3 weeks.

Lack of institutional support can be a significant impediment to expert involvement in disaster response, and individuals often volunteer at significant personal cost and sacrifice. In addition, home institutions are reluctant to support the unexpected absence of important personnel. Pre-planning can help overcome this barrier. Importantly, a commitment could be sought from individuals' home institutions to endorse and facilitate the absence of required personnel in emergent situations. The pursuit of institutional endorsements would be given additional credence if brokered by appropriate organizations (ISCOS, WHO) on behalf of individuals. Institutions could then develop contingency plans in advance to compensate for the absence of important personnel. Teams and individuals would be committed to a pre-identified minimum time frame to minimize disruptions in continuity.

Initial survey and assessment

Identified challenges. The first step in effective disaster response is the assessment of the scope and nature of needs. Such information includes an estimation of the number of persons with SCI as well as the types and severity of injuries; the existing capacity of the region (acute and rehabilitation); availability of human resources (e.g., skilled nursing, therapists, physicians); access to equipment; and obstacles to community re-integration. There is also a need to determine the impact on individuals living with established SCI. The importance of this activity cannot be overstated, as initial assessment guides decision-making about the deployment of valuable, life-sustaining resources as well as emergent and long-term needs planning.

Unfortunately the performance of an accurate survey is difficult for a constellation of reasons, including delayed recognition of SCI by emergency workers, and lack of data collection or patient tracking early post disaster. Ultimately, the success of the initial survey is dependent on the timely collection of reliable data. This requires getting appropriate personnel mobilized and on the ground, collaborating with the identified coordinating bodies. In the absence of the requisite expertise, information arrives with insufficient detail and is of questionable validity. The lack of essential information is a major barrier to effective planning and disaster response (7).

Possible solutions

As reviewed above, databases can aid in getting the required human capital on the ground. International organizations (e.g., ISCOS, Handicap International (HI)) can play a role in developing a framework to guide needs assessment specific to SCI. Checklists can facilitate the process. HI utilized a Rapid Assessment Tool to identify the emergent needs of persons with SCI and amputations following the Haiti earthquake (author observation). Developing a framework in advance allows sufficient time for deliberation and ensures a consistent and comprehensive approach to needs assessment in the context of future disasters. For areas at particularly high risk for sudden onset disasters (e.g., earthquakes), consideration should be given to proactively surveying and determining available expertise and resources specific to SCI.

Health care delivery for affected individuals

Identified challenges. Caring for SCI in a low resource environment post-disaster is challenging to say the least. After an earthquake, trapped individuals are often recovered by family, friends, and community bystanders (4, 12), with little regard for immobilization and preventing further neurological deterioration (4, 12, 14–16). An additional issue, that was apparent in Haiti, is the need for appropriate recordkeeping and follow-up. Not surprisingly, documentation is often a secondary concern in the chaos that follows a disaster (1).

Identifying the requisite clinical expertise (see above) is challenging in a setting where it might not have previously existed. This has been the authors experience in Haiti post-earthquake. Expertise has to be leveraged, when in short supply, to maximize the benefit. Resources can also be in short supply, thus precluding traditional approaches to medical management. As a result, treatments have to be adapted to the local context. In rural regions of Pakistan, it is not uncommon for able-bodied individuals to simply go into the fields to attend to bowel needs (17). Toileting facilities can preclude safe transfers and positioning for individuals with SCI. Fixed in-ground commodes (squat toilets) common in many parts of the Middle East, Asia, and Africa require the individual to squat on bent knees over an opening rather than sit (17). Social beliefs can also discourage independence, such as an expectation by family members to care for an impaired individual (2, 17). On the other hand, family members can be taught to assist with positioning and contracture prevention, turning, and skin inspection; and are a valuable resource in cultures with a tradition of strong family support.

Finally, timeliness of care is an issue. Ideally rehabilitation should be initiated as early as possible. A recent report[1] following the 2008 Sichuan earthquake found that rehabilitation was initiated for the majority of individuals greater than two months post-event, and rehabilitation effectiveness was inversely correlated to time to rescue and initiation of rehabilitation.

Possible solutions. The issue of immobilization and transport should be addressed proactively in high risk areas; particularly earthquake prone regions. Specific suggestions include the de-

[1] Li Y, Reinhardt JD, Gosney JE, Zhang X, Hu X, Chen S, Ding M, Li J. Functional outcomes of physical rehabilitation and medical complications in spinal cord injury victims of the Sichuan earthquake. Submitted manuscript.

velopment of pre-emptive education and awareness campaigns. Immobilization devices (i.e., spinal boards) are also unavailable in many regions, and there is an urgent need for alternative devices and approaches to transportation in remote regions.

An important consideration is whether to cohort persons with SCI following a disaster. Cohorting leverages available expertise and builds a critical threshold of experience with SCI. Cohorting individuals also facilitates staff training, which otherwise can be fragmented, and helps procure required resources since there is an identifiable entity (18). SCI centers were successfully established following the 1988 Armenian earthquake (19), 2005 Pakistan earthquake (18), and 2010 Haitian earthquake (4). The Armenian center was established after the government and the Soviet Red Cross appealed to the IFRC (19).

Medical treatments have to be appropriate to the local environment and culture. Current realities in many regions of the world preclude a resource intensive approach to the management of SCI. This is particularly true when care for a low incidence condition like SCI competes with basic needs such as vaccination, etc. As demonstrated following the earthquake in Haiti, even the most severe wounds heal with meticulous attention to nutrition, hygiene, and wound care (20). Stage IV pressure ulcers and surgical wounds with exposed metal healed with regular gauze dressing changes with normal saline, judicious application of diluted povidine-iodine to exposed metal, the provision of balanced, protein rich meals, and no antibiotics.

Bowel and bladder management also has to be adapted. Intermittent catheterization (IC) is the preferred method for managing neurogenic bladder dysfunction following SCI. In lieu of new catheters, alternative strategies (e.g., diluted bleach) are often required for cleaning urinary catheters. IC has been utilized successfully in Haiti (Stephenson FJ. Personal communication, 2011). This has been attributed to explicit education regarding proper technique, timing of catheterization, hygiene and the consequences of poor attention to these details. Many individuals cannot afford to pay for individual use catheters, therefore they are taught to clean them meticulously with safe water and soap, dry by swinging in a circle (centrifugal force) and store in a cotton container. The storage is important. A simple cotton sock protects catheters from humidity, contamination, and bacterial growth. Catheters are used for 9–12 months with minimal urinary tract infections (UTIs).

Equipment needs to be durable and reparable; ideally by the injured individual or family. If self-repair is not practical, the injured individual needs an identified resource to access for equipment issues. In Haiti, dispensed wheelchairs were specifically designed for rugged environments (RoughRider wheelchair, Whirlwind Wheelchair International, San Francisco, CA, USA) (4). Technology intensive equipment is prone to damage and difficult to repair as well as maintain. Its usage should therefore be minimized; otherwise donated equipment can go unused (2). In Iran, few of the individuals who received Roho cushions knew how to inflate them properly (2).

Cost is another important consideration. Low cost alternatives (e.g., wheelchair cushions) are urgently needed (21, 22), and mechanisms should be instituted to increase awareness of and access to alternatives. Non-profit organizations and governments can play a vital role when there is little motivation for private industry, given low profit margins. The WHO published guidelines for the provision of wheelchairs in less resourced settings (23).

Simple tools (e.g., checklists) and documents to guide the management of key issues in resource poor environments are invaluable. Following the 2008 earthquake in the Sichuan province of China, HI developed tools for staff training, patient education, treatment (e.g., checklists and guidelines), and patient management (assessment forms, patient databases, etc.) (24). An additional example of such an effort is the Guidelines for Care of Persons with Spinal Cord Injury in the Community, developed in India under the Government of India WHO Collaborative Programme (25). To maximize access and utilization by the broadest possible audience, information should be available in multiple formats including print (large font, plain language), audio, and pictorial (e.g., diagrams).

The importance of record keeping and clinical documentation, as well as communicating required follow-up, cannot be overstated. Understanding preceding medical events is essential to providing quality care, and the absence of records compromises future decision-making and care. Professional societies can provide guidance and clarity on the information required to provide optimal care to persons with SCI. The international SCI data sets are a natural starting point (26).

Community reintegration and health maintenance

Identified challenges. A primary goal of rehabilitation is successful community reintegration. The reality of this goal in many settings is questionable. Following the 2005 earthquake in Kashmir Pakistan, many persons discharged to homes in hilly terrain were readmitted within weeks for pressure ulcers and UTIs (13). At the time of that publication, only 1 of 187 individuals had returned to their prior occupation. In the interim, one of the authors (F.A.R.) reports that 4 additional individuals have returned to a wage earning occupation, and an additional 8 have died. Many young individuals remain institutionalized. In a study of 26 individuals with SCI, one year post return to the community, following the Sichuan earthquake in China (27), nearly half suffered a new pressure ulcer and greater than 50% had urinary complications, despite the fact that 20–26 SCIs were incomplete. Only 4 individuals had returned to paying jobs. Encouragingly, there were improvements in overall functional status (Modified Barthel Index), physical independence, mobility, and self-reported quality of life including satisfaction with social relations.

Many communities are essentially inaccessible to individuals with mobility impairments, rendering the individual a virtual prisoner in his or her home, completely reliant on family and friends. The construction of accessible housing and communities is a controversial but important topic. In Pakistan, some custom-made homes were built with the involvement of the government, WHO, and NGOs (13). Building accessible single units in otherwise inaccessible communities still leaves the wheelchair dependent individual largely confined to the home. On the other

hand, it has been suggested that dedicated accessible multi-unit housing developments or communities isolate persons with SCI from the larger community, and is the antithesis to community reintegration. This sentiment, however, needs to be tempered against current reality in many countries.

Achieving adequate follow-up and keeping individuals healthy is a significant challenge. Important social and vocational supports are often lacking, and individuals are often lost to follow-up in low resource and/or post-disaster settings. Eight months after the 2003 Iran earthquake, Raissi and colleagues (2) were only able to locate 61 of 121 individuals with SCI. Meeting the long-term needs for cervical SCI is particularly challenging; follow-up from the 2005 Pakistan earthquake revealed that few if any individuals with tetraplegia survived (13).

While not specifically post-disaster, long-term survival in low-resource settings is often disappointing. A report from the low resource nation of Nigeria found that only 3% of wheelchair bound individuals kept their initial follow-up appointment after discharge, and by the 2nd appointment the rate had dropped further to 1.5% (28). In a study of 24 individuals with SCI from Sierra Leone, 15 individuals were dead and four were lost to follow-up after 28 months post-injury (29). Of the 5 survivors, 2 had incomplete cervical injuries and were ambulatory. The other 3 had complete thoracolumbar lesions.

Possible solutions. In the setting of inaccessible environments and limited transportation, mobile teams can reach individuals in their homes and communities, and have an important role to play in ensuring proper follow-up and maintaining long-term health (8, 30). Mobile teams have been utilized in Haiti and Pakistan. One limitation has been that teams often consist solely of therapists, thereby limiting their ability to intervene medically (7). One ambitious effort to reach patients in the rural villages of India was called the Paraplegia Safari (30). The outreach team included an orthopedic surgeon, physiotherapist, occupational therapist, prosthetic and orthotic engineer, medical social worker, and a nurse. Even under these circumstances, 282 of 787 patients could not be located for follow-up. Alternatively, mechanisms can be instituted to transport vulnerable individuals for important follow-up. In Haiti, funding has been established from the non-profit sector, to transport persons with SCI to a follow-up clinic in Port-au-Prince (authors observation).

Patient registries are important for tracking patients and delivering appropriate follow-up. Meticulous attention needs to be paid to the accuracy of contact information, and clients should be informed of the importance of follow-up and updating contact information with health care providers (30). In post-earthquake Haiti, a database has been established to facilitate follow-up and health maintenance (authors observation). A nurse who sustained a SCI is employed at an outpatient clinic, and provides regular phone follow-up and screens for health issues while providing mentor support.

Sustainability and capacity building

Identified challenges. Traditionally, disaster response has underemphasized the implications of large scale disability and impairments following a sudden onset disaster. Planning for long-term needs and sustainability (including rehabilitation and health maintenance) is as important as the acute response, and should be initiated immediately after the onset of the disaster. In developing regions, the biggest barriers to long-term sustainability are the availability of required fiscal and human (expertise) resources.

A disaster can highlight and bring attention to conditions, such as SCI, that previously were largely invisible. In some circumstances natural disasters have led to the establishment of permanent spinal units, development of SCI expertise, and enduring improvement in the capacity of affected regions to care for individuals with SCI. This therefore presents an important opportunity.

Potential solutions. The involvement of early responders is typically time limited. Training opportunities are therefore crucial in the aftermath of a disaster to develop local expertise and long-term capacity. The international community (e.g., ISCOS, WHO, International Society of Physical and Rehabilitation Medicine (ISPRM), HI, Medecins Sans Frontieres, IFRC, etc.) can contribute by providing training opportunities, locally and internationally at established SCI centers around the world. Regional workshops, such as those offered by ISCOS, have been rated as very helpful by participants (31). The international community can also contribute by financially supporting attendance at appropriate international conferences and meetings. Organizations such as the Toronto Rehabilitation Institute, Team Canada Healing Hands, and the Academy of Spinal Cord Injury Professionals (US) supported clinician attendance at international meetings in the aftermath of the Haiti earthquake. Such efforts were important to the establishment of SCI centers in Haiti (author observations).

The reality, however, is that even when one has interested and capable people, the lack of resources can derail the best intentions. The experience of established centers, outside the disaster context, can provide valuable guidance. Two centers in Nepal (Green Pastures Hospital and Rehabilitation Centre in Pokura; Spinal Injury Rehabilitation Centre in Saanga, Kavre) have sustained operations and grown with minimal government funding (Wee J. Personal communication, 2012) (32). It is typically unrealistic to charge injured individuals the cost for providing care; therefore the majority of activity has been donor supported (individual and foundation). Ongoing, local fund-raising (e.g., charitable events) is also important. Familial supports are strong in many cultures, and SCI centers in Nepal, Pakistan, and Haiti have managed human resource costs by engaging family members in the provision of care, and even having them stay on site (32, author observations). The long-term strategy of the Spinal Injury Rehabilitation Centre in Nepal is to derive operational funds from three sources – a third from government support, a third from establishment of a corpus fund (endowment), and a third from continuous fund raising (32).

Support and partnerships with local organizations and government need to be ongoing. Since 2003, HI Belgium has supported seven SCI units in Vietnam (33). The Swiss Paraplegic Foundation has partnered with Haiti Hospital Appeal in Cap Haitien

to build, train, and staff a permanent unit (authors observations and correspondence). HHH administers a follow-up clinic in Port-au-Prince, organizes a peer support group, provides SCI literature (Creole and French), conducts ongoing training and dispenses SCI specific medication. ISCOS established a Disaster Relief Committee, and partnered with WHO for the stated goal of improving SCI management in low and middle income countries (34). The ISPRM established a Committee on Rehabilitation Disaster Relief and conducted a Symposium on Rehabilitation Disaster Relief at their 6th World Congress in San Juan, Puerto Rico, in June 2011 (35).

Efforts can have long-term ramifications. A permanent spinal injuries unit was established in Armenia following the 1988 earthquake (19). Eight makeshift spinal units were established in Pakistan following the 2005 earthquake, and the National Institute for Handicapped has been developed into a permanent center (12, 36). The 2010 Haiti earthquake led to the organization of 4 facilities providing SCI care and rehabilitation – Haiti Hospital Appeal in Cap Haitien (northern Haiti), Project Medishare in Port-au-Prince (central Haiti), St. Boniface Hospital in Fond-des-Blancs (southern Haiti), and HHH (Port-Prince) (4). In Haiti, the enhanced capacity has led to improved survival following SCIs from alternative causes (e.g., traffic accidents and falls).

CONCLUSION

It is a certainty the global community will be impacted by future disasters. In this context, improved rapid response will lead to the increasing survival of individuals with catastrophic injuries and accompanying long-term needs and impairments; many of whom will have SCIs. Addressing the needs of individuals with SCI is particularly challenging when disasters strike low resource environments. Fortunately, the fields of SCI medicine and disaster planning can learn from prior experience when looking to the future. The international community should proactively address how these challenges will be met when the need once again arises.

Summary of Recommended Measures

Coordination and mobilization	Consult with government or coordinating bodies prior to deployment. Coordinate post-deployment activities through designated body. Plan in advance, as much as possible, for predictable issues. Establish local linkages between organizations with shared objectives. Augment civilian response through collaboration with military.
Identifying and procuring required expertise	Establish databases of SCI experts for disaster response. Define expectations & responsibilities for responders. Develop standards and mechanisms for vetting and credentialing experts. Provide cost-effective training opportunities (e.g., webinars). Use professional societies to procure institutional support for participants. Establish minimum time commitments for database participants. Utilize organizations with pre-existing involvement in the impacted area.
Initial survey and assessment	Develop specific tools to assess emergent SCI needs. Consider the implementation of simple tools such as checklists. For high risk areas, proactively survey expertise and resources.
Health care delivery	Consider pre-emptive campaigns to increase awareness of immobilization and transportation requirements in high risk areas. Develop alternative methods for safe transportation in remote regions. Establish standards for record keeping applicable to SCI. Develop simple tools (e.g., checklists) and reference documents for acute and rehabilitative care. Cohort individuals in designated SCI centers. Adapt treatment approaches to local environments, resources and cultures. Facilitate awareness and access to low-cost alternatives. Favor simple equipment over technology intensive options. Dispense durable equipment and institute mechanisms for maintenance. Educate impacted individuals regarding the appropriate use of equipment. Provide information in multiple formats (print, audio, pictorial).
Community reintegration and health maintenance	Consider construction of accessible homes and/or communities. Employ mobile teams, or facilitate patient transport for follow-up. Establish patient registries and tracking mechanisms. Utilize patients as peer mentors, and consider peer support groups.
Sustainability and capacity building	Initiate sustainability planning immediately after a sudden disaster. Provide local & international training opportunities. Support attendance at international conferences and meetings. Facilitate ongoing donor support (individual, foundation). Establish local, fundraising (charitable) events. Develop ongoing partnerships with local organizations and communities.

With the preservation of life comes a responsibility to provide mechanisms for ongoing care and a humane quality of life.

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