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REVIEW

Pressure ulcers in people with spinal cord injury in developing nations

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Study design: Literature review.
Objectives: To explore the prevalence or incidence, risk factors, and costs of pressure ulcers among individuals with spinal cord injury (SCI), specifically in the context of the developing world. To highlight important targets for intervention and research for pressure ulcer management the world over.
Setting: World Bank 'low-income' and 'middle-income' countries with a gross national income per capita <$12 746.
Methods: PubMed search.
Results: SCI-associated pressure ulcers are very prevalent in developing nations; however, reported prevalence and incidence numbers are highly variable. Risk factors for pressure ulcers are similar in developed and developing countries however many of the risk factors are more prevalent in developing nations.
Conclusion: SCI-associated pressure ulcers are common but can be prevented in the developing world. Key targets for interventions include acute care, nurse-to-patient ratios, support surfaces and education.
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INTRODUCTION

Despite many advances in spine surgery and rehabilitation medicine, there remain significant morbidity and mortality associated with spinal cord injury (SCI). Even the seemingly simple problem of pressure ulcers (PUs) remains a common SCI complication. In developing nations, defined here as World Bank 'low-income' and 'middle-income' countries with a gross national income per capita <$12 746,[1] SCI care providers face unique challenges inherent in resource scarcity. Following injury, individuals in developing countries may travel for days over rough terrain just to reach a medical facility able to address their needs. These facilities often lack such basic equipment as pressure relief mattresses and patient-to-nurse ratios are typically high. Even if fortunate enough to meet a spine surgeon, few spinal cord injured patients in these countries will encounter a trained rehabilitation specialist.[2] Finally, reintegration into the community after discharge is awash in obstacles such as environmental inaccessibility, limited adaptive equipment, financial hardship and, frequently, social isolation.[3] One might expect the combination of any number of these scenarios to increase the rate of SCI complications such as PUs in developing nations. Indeed, Burns and O'Connell[4] noted that PUs affect 'practically 100%' of people with SCI in the developing world.

PUs are not specific to SCI but are frequent complications of hospitalized and immobilized patients in numerous clinical scenarios.[5] Nevertheless, the sensory loss, motor impairment and skin changes of SCI make individuals with SCI uniquely vulnerable to PU development. Importantly, there are also external and modifiable risk factors for PU formation. Many of these modifiable risk factors are more prominent in developing nations.

The challenges of SCI care in developing countries have been described previously.[6] That said, in light of recent publicity surrounding natural disasters such as the earthquakes in Pakistan (2005), China (2008) and Haiti (2010), there has been a resurgence of interest in improved rehabilitation medicine in the developing world.[3,4,7,8] Physicians and researchers in these parts of the world are starting to document local SCI care and complications, including information about the prevalence and management of PUs. To the authors' knowledge, there are currently no literature reviews compiling these data and examining the prevalence of PUs in the developing world. This article is a compilation and analysis of these papers about SCI-related PUs in the developing world that examines the prevalence and explores the risks, costs and possible solutions to this common problem.

MATERIALS AND METHODS

A PubMed search of journal articles written in English between 1998 and August 2014 was carried out using the following search terms: 'spinal cord injury', 'pressure ulcers'. This resulted in 938 references. The abstracts of relevant titles were reviewed and, when relevant and available, the full text was then reviewed. This search yielded 17 articles containing pressure ulcer prevalence or incidence data in developing nations. A citation review of these 17 articles and of Burns and O'Connell[4] captured six more articles that had been missed in our initial search. The majority of articles were of low level of evidence, such as case series or expert opinion papers. There were no controlled trials, case–control studies or systematic reviews.

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Table 1 List of studies reporting pressure ulcer prevalence or incidence data in developing countries

Country (World Bank economic classification)	*Author (year)*	*Brief description of study design and timing (notable pt demographics)*	n	*Phase*	*Prevalence (P) or incidence (I) of pressure ulcers in %*
Brazil (UM)	Nogueira *et al.*[12]	Retrospective review of tSCI pts acutely admitted under orthopedic and neurosurgical management. (44% thoracic, 40.4% cervical. Injury completeness not specified.)	47	Acute hospitalization	*P*=42.5
South Africa (UM)	Frielingsdorf and Dunn[13]	Descriptive analysis of cervical SCI pts managed in non-rehabilitation 'acute spinal cord injury unit.' (57% pts within 2 days of injury. 35 complete injuries. 20 with no neurologic deficit.)	101	Acute hospitalization	*P*=11 (on admission); P=11 (during admission)
Pakistan (LM)	Tauqir *et al.*[14]	Cross-sectional descriptive study of tSCI pts (earthquake victims) admitted to surgery/neurosurgery departments. (50% AIS A and B. 62% lumbar.)	194	Acute hospitalization	*P*=20
Nigeria (LM)	Obalum *et al.*[15]	Retrospective review of tSCI pts at a teaching hospital responsible for all care post injury until pt can be safely discharged home. (LOS 2–60 weeks. 93% AIS A. 59.4% lumbar.)	468	Acute hospitalization	*P*=3.6 (on admission); P=31.2 (during admission)
Brazil (UM)	Santos *et al.*[16]	Prospective evaluation of pts during acute hospitalization for 'severe cervical trauma' with or without neurologic deficit. (95 AIS E pts.)	217	Acute hospitalization	*P*=3.7
Nigeria (LM)	Iyun *et al.*[17]	Prospective evaluation of tSCI pts acutely managed on neurosurgery ward (LOS 1–258 days. 67.2% complete tetraplegia. 19.4% complete paraplegia.)	67	Acute hospitalization	*P*=20 (on admission); P=47.7 (during admission)
China (UM)	Wu *et al.*[18]	Retrospective study of tSCI pts. (42.2% AIS A or B. 71.2% cervical.)	631	Acute hospitalization	*P*=2.7
Bangladesh (L)	Islam *et al.*[20]	Cross-sectional survey of SCI pts at time of admission to rehabilitation program 1 day to 3 years after injury. (78% AIS A. 44% cervical.)	107	Pre-rehabilitation	*P*=43
China (UM)	Li *et al.*[3]	Prospective cohort study of SCI pts at time of admission to rehabilitation center. 94.1% admitted within 4 months of injury. (43.1% complete. 91% thoracic or thoracolumbar.)	51	Pre-rehabilitation	*I*=47.1
South India (LM)	Nair *et al.*[22]	Prospective study of ntSCI pts at an inpatient rehabilitation center. Pts admitted mean of 19.8 weeks after symptom onset. (Mean LOS 76.6 days. 78.1% paraplegic.)	297	Rehabilitation	*P*=29.9
Pakistan (LM)	Rathore *et al.*[19]	Prospective observational study of tSCI pts admitted to rehabilitation unit. (71.1% paraplegics. 57.8% complete)	83	Pre-rehabilitation Rehabilitation	*P*=39.7 (on admission); P=2.4 (during admission)
Nigeria (LM)	Idowu *et al.*[21]	Prospective study of tSCI pts at regional 'spinal and rehabilitation center'. 46% of pts admitted within 24 h of injury. (60% AIS A.)	105	Rehabilitation Pre-rehabilitation	*I*=57.1 (throughout admission); *P*=13.9 (on admission)
Sri Lanka (LM)	Armstrong *et al.*[23]	Descriptive study of SCI pts admitted to MSF-run rehabilitation unit. 91% of patients were >6 months since injury. (43% AIS A. 74% thoracic.)	51	Pre-rehabilitation +rehabilitation 6–12 weeks after rehabilitation discharge	*P*=56.9; *P*=5.9
Zimbabwe (L)	Levy *et al.*[26]	Questionnaires sent to tSCI pts 1 year after rehabilitation discharge. (33% cervical AIS A, 28% thoracic/lumbar AIS A)	60	Chronic	*P*=33
Afghanistan (L)	Deconinck[30]	Cross-sectional survey of tSCI pts. Home or clinic visits. Mean 8 years after injury. (47% thoracic, 45.7% lumbar. 80% complete.)	311	Chronic	*P*=32
Iran (UM)	Raissi *et al.*[24]	Survey and exam of tSCI pts (earthquake victims) in their communities 8 months after injury. (67% thoracic, 26% lumbar. Injury completeness not specified.)	54	Chronic	*P*=35.2
Brazil (UM)	Blanes *et al.*[25]	Questionnaires of outpatient paraplegic tSCI pts done at hospital, rehabilitation center, sports association or home 6 months–17 years after injury. (Injury completeness not specified)	60	Chronic	*P*=26.7
India (LM)	Singh *et al.*[29]	Cross-sectional survey of tSCI pts 6 months to 20 years after injury (mean 3.7 years). (40% AIS A or B, 12% AIS E. 38% cervical.)	50	Chronic	*P*=36
China (UM)	Hu *et al.*[27]	Cross-sectional survey of community dwelling tSCI pts (earthquake victims) 1 year after rehabilitation discharge. (76.9% incomplete. 68.6% thoracolumbar)	26	Chronic	*P*=46.2

Table 1 (Continued)

Country (World Bank economic classification)	*Author (year)*	*Brief description of study design and timing (notable pt demographics)*	*n*	*Phase*	*Prevalence (P) or incidence (I) of pressure ulcers in %*
Nepal (L)	Scovil *et al.*[28]	Cross-sectional survey (home visits) of SCI pts 11–27 months after rehabilitation discharg. (50% complete paraplegia, 42% incomplete paraplegia)	24	Chronic	I=54 (since discharge); P=37.5 (at home visit)
Iran (UM)	Eslami *et al.*[31]	Mobile rehabilitation teams visited homes of tSCI and ntSCI pts in the community. (66.8% paraplegia, 9.6% tetraplegia, 14.8% 'paresia')	7489 (all) 5752 (≥11 year old) 815 (<1 year since injury) 5897 (>1 year since injury)	Chronic	P=34.6; P=38; P=45; P=35
Thailand (UM)	Wannapakhe *et al.*[32]	SCI pts interviewed 6 months after rehabilitation discharge (average of >38 months after injury). (50 'wheelchair-bound', 50 'ambulatory')	100	Chronic	21/50 wheelchair-bound pts developed 1–4 PUs; 3/50 ambulatory patients developed 1–2 PUs over a 6-month period
Iran (UM)	Javadi *et al.*[33]	3 year prospective monitoring study of chronic tSCI pts (victims of Iraq–Iran war 1980–88) >10 years after injury. (91% AIS A. 63% thoracic injuries.)	1506, 1684, 1803	Chronic	I=14.67 (2007 annual incidence); I=12.47 (2008); I=10.65 (2009)

Abbreviations: AIS, American Spinal Injury Association Impairment Scale; LOS, length of stay; LM, lower middle-income economy ($1046–$4125);[1] MSF, Médecins Sans Frontières; ntSCI, nontraumatic SCI; pt, patient; SCI, spinal cord injury; tSCI, traumatic SCI; UM, upper middle-income economy ($4 126–$12 745).[1]

RESULTS

It is currently impossible to accurately report the true prevalence of SCI-related PUs in the developing world. In many parts of the world, the prevalence of SCI itself is unknown. First, the concept of the 'developing world' encompasses a heterogeneous group of countries with variable resources and cultural attitudes towards health and disability. Second, practitioners of rehabilitation medicine, and therefore data on rehabilitation medicine, are very scarce in many of the world's poorest nations, areas where one might imagine medical complications of SCI to be the greatest. Finally, people with SCI are often relegated to remote and rural homes far from mainstream society, making data collection quite difficult.[9–11]

As demonstrated in Table 1, prevalence and incidence data about SCI-related PUs is highly variable, which may or may not reflect reality. Eleven articles reported PU prevalence during initial inpatient hospitalization and/or prior to rehabilitation admission[3,12–21] and four articles report PU prevalence or incidence during SCI rehabilitation programs.[19,21–23] The demarcation of this time period, however, was as variable as 1 day to 3 years post injury, making comparison and discussion of these prevalence statistics challenging. Ten articles were identified that reported the prevalence or incidence of PUs in community dwellers from 6 months to 20 years after injury.[24–33] Of note, very few of these study subjects were reported to have undergone SCI rehabilitation. These 10 papers reported a PU prevalence of 26.7–46.2%, mean of 35.2%. The only paper to cite a PU prevalence <30% (26.7%) was drawn from a population only of persons with paraplegia in Brazil.[25]

Although this is an alarmingly high PU prevalence, this probably under-represents the true prevalence of PUs in the developing world. Many of the world's poorest nations with the highest SCI-associated mortality are not represented in these statistics.[34] In addition, the hospitals and clinics that performed the cited studies may not have the financial resources or infrastructure to document and report all PUs reliably.[28] Furthermore, individuals with more severe mobility impairments and those who live remotely are unlikely to be captured by such studies because of limited transportation options in many low resource communities.

Even if only a rough estimate, the findings above do suggest that the prevalence of PUs in developing nations is greater than in the developed world. By contrast, Chen *et al.*[35] reported a PU prevalence of 11.5% at 1 year after injury and 21% at 15 years post injury in the United States.

A description of SCI-related PUs is incomplete without addressing risk factors, costs, consequences, prevention and management strategies. The following discussion will focus on these issues specifically in the context of the developing world.

DISCUSSION

Risk factors

Even though most studies identifying risk factors for PU formation have originated in the developed world, the identified risk factors are undoubtedly also germane to SCI care in the developing world. Furthermore, many of these risk factors are more commonly encountered in developing countries.

Income. Low household income in the United States is associated with increased PU risk.[36] Although this association has many confounding variables and is difficult to extrapolate to nations where average annual income is often a small percentage of that of the United States, decreased financial resources probably increase PU risk worldwide. One could speculate, for example, that financially poor

individuals would be unable to afford quality pressure relief cushions, mobility aids, caregiver support and/or proper nutrition. In addition, low household income might have a more pronounced effect on SCI complication rates in regions where healthcare expenses are predominantly paid out-of-pocket and significant medical events have catastrophic effects on family finances.[37] Finally, there are typically fewer social welfare programs provided by the governments of these regions to assist the poor in accessing healthcare.[38]

Education. Fewer years of education has been identified as a risk factor for PU development in several studies from developed nations.[39,40] In developing nations with comparatively low average educational level, this is also a significant barrier to care and a risk factor for SCI complications.[8,9,31,41] Educational deficiencies in these nations are twofold. First, people who suffer a SCI often have fewer years of education and poor health literacy. Second, and perhaps more importantly, few care providers in the developing world have had formal SCI education.[2,42] Because these healthcare providers lack SCI training, they struggle to manage PU risk factors in their patients and often fail to educate their patients about ongoing PU prevention strategies. In their letter to the editor responding to the 2012 study of PU risks in Iran by Eslami *et al.*,[31] Rathore and Mansoor[43] note that 'lack of knowledge regarding PU prevention on the part of the doctors' is one of the 'four major reasons for PU occurrence' in Pakistan. Indeed, without access to specialty guidance, even the most educated and motivated person with SCI is prone to complications.

Immobility. Patient immobility is a known risk factor for PUs. When investigating activity level among people with SCI in developing countries, it is important to also consider nonphysical barriers. In countries such as Pakistan and Nepal, the mobility of individuals with SCI is 'restricted' by environmental and social barriers: 'A quadriplegic in a developing country leads a very restricted life in most of the cases. Majority of them are confined to their homes and spend most of the time in their beds or wheelchairs, with no regular pressure relief.'[43] 'Based on self-report, participants spent an average of 5 h per day in their wheelchair. The remaining time was spent primarily in bed. Two had no mattresses on wooden bed frames; the rest had mattresses made of locally available foam or cotton materials.'[28] As these authors illustrate, mobility may be limited by more than neurologic deficits. Shore and Juillerat[44] have shown that by increasing mobility through donated wheelchairs, neurologically impaired patients in Vietnam, Chile and India had a significant decrease in PUs. Their proposed explanation is that wheelchair propulsion maneuvers induce pressure relief. Their study also demonstrated that increased community mobility was associated with increased access to care, decreased pain, increased positive mood and improved daily feelings about life.[44] One could posit that these additional benefits may also directly or indirectly affect PU development. Taken together, in regions of the world where SCI is hidden from society and/or where inaccessibility and adaptive equipment limitations make activity difficult, individuals with SCI enjoy less mobility and therefore incur greater PU risk.

Other. Although far less numerous than articles from well-resourced countries, several studies identifying risk factors for PU formation have emerged directly from developing countries. In Nigeria and Turkey for example, malnutrition has been shown to be a risk factor for PU formation,[21,45] a finding with mixed evidence in the developing world.[40] This is of notable significance given the increased prevalence of malnutrition in developing countries and the fact that malnutrition is known to impair wound healing.[46,47]

In 1988, Mawson *et al.*[48] demonstrated the influence of acute SCI management on PU development in the United States. Despite improved acute SCI management in the developed world, this remains a major issue in developing countries with many illustrative examples. In Nigeria, Ahidjo *et al.*[49] found that only 5.4% of spinal cord injured patients were transported to the hospital by ambulance, and 67.9% presented >24 h after injury. Meanwhile, Idowu *et al.*[21] found that delayed hospital presentation after injury in Nigeria was associated with more PUs at the time of admission. In South Africa, Fielingsdorf and Dunn[13] reported an 11% incidence of PUs on initial presentation that was attributed to delayed admission due to 'patients being transported over extensive distances' on 'hard fracture boards'. In Zimbabwe, Levy *et al.*[26] reported that patients 'rarely' reach proper care in <24 h and they are 'invariably picked up by unskilled people' with 'inadequate transport'. Rathore *et al.*[19] depicts the epitome of unskilled pre-hospital transport in the description of an SCI patient in Pakistan who 'was brought to the hospital on a bullock cart'. Even in parts of Brazil, only 21% of SCI patients were admitted to the hospital within 4 h of trauma with 11.6% hospitalized >48 h after injury secondary to long transport time.[50] In contrast, in New South Wales, the average time until admission after traumatic SCI is 12 h.[51] Importantly, early PUs are preventable with the implementation of pre-hospital transport protocols.[52]

Costs and consequences

PUs beget significant morbidity and mortality among individuals with SCI the world over. By breaching the protective skin barrier, PUs lead to local, systemic, chronic or even life-threatening infections.[53] PUs and their associated infections are associated with increased re-hospitalization rates,[28,54] increased duration of hospitalization,[21] decreased life expectancy and death.[26,34,54–57]

The costs of PUs extend well beyond the expense of infectious complications. PUs impair quality of life due to pain, disfigurement, fear and anxiety.[58] Individuals with PUs are less likely to be employed, engage in fewer social outings and have decreased leisure time activities.[56,59] Early PUs prolong acute hospitalization, delay initiation of rehabilitation and, in some cases, completely preclude admission into rehabilitation centers.[13,54] In purely economic terms, PUs are very expensive.[17,56,60] Cost estimates for PU care in all-comers have been reported as high as $9000 Canadian a month for community dwellers with high grade ulcers, $130 000 American per hospital admission for hospital-acquired ulcers in the United States and up to 4% of the National Health Service Expenditure in the UK annually.[60–62] Although such estimates are difficult to extrapolate to developing world settings, it has been reported that PUs account for one-fourth of the cost of caring for SCI patients in Nigeria.[17] Although imperfect, these cost estimates certainly highlight the financial toll of PUs.

Prevention and management

Over 50 years have passed since Sir Ludwig Guttmann[63] wrote that, 'there is still a definite lack of guidance in the prevention and treatment of bed sores, and our teaching methods to students of both the medical and the nursing professions could be vastly improved in this respect'. This sentiment still holds true, especially in developing countries. Given the high prevalence and cost of PUs in both SCI and non-SCI populations, there are a multitude of studies on PU prevention and management. Although recent research has supported a variety of new, 'high tech' management approaches to PUs, many of these interventions are impractical or financially prohibitive in developing nations. Nonetheless, there exist low-cost, proven strategies

that could constitute an effective foundation for PU prevention and management in the developing world.

Repositioning. The best management strategy for PUs is prevention, and patient repositioning has been the foundation for PU prevention since the days of Guttmann.[58,63] Though a simple intervention, patient repositioning can be quite resource intensive, particularly for those who require significant physical assistance for turning. Patient repositioning highlights an important issue in developing nations: nurse-to-patient ratio. In a Nigerian teaching hospital, for example, a single nurse is responsible for seven SCI patients.[17] If a patient is to be turned every 2 h, with seven patients assigned to one nurse and several minutes dedicated to each turning maneuver, effective repositioning alone could consume a third or more of a nurse's time. Moreover, patient turning often requires more than one attendee. Numerous authors have thus highlighted the necessity of increasing the ratio of nurses-to-patients[15,17,64] or even the establishment of dedicated 'turning teams'.[26]

In places such as Nigeria and Turkey with low nurse-to-patient ratios, the burden of many basic patient care activities, such as repositioning, often falls on family members and friends.[65,66] Nursing staff are encumbered by the more 'essential' tasks of administering medications and monitoring vital signs and thus have limited time for 'caring activities' such as patient turning.[65] In Nigeria and Uganda, training family members in patient care is not only effective but also essential to successful patient outcomes.[66,67] In fact, for Nwankwo's (2003) 12-week rehabilitation program in Nigeria, having an adult care aid present was a prerequisite for program participation. Unfortunately, dedicated caregivers are not always available. As underscored by Gosselin and Coppotelli[34] in Sierra Leone, 'caregivers already stretching their survival skills on a daily basis, have little time or resources to prevent or treat complications such as pressure sores'.

Family participation is heavily influenced by cultural beliefs and socioeconomics. Moreover, the use of family members as care providers can have both positive and adverse effects in SCI. On one hand, family involvement has been shown to 'foster co-operation' and 'non-abandonment' of disabled relations.[66] On the other hand, too much family involvement can actually impair the development of independence of the individual with SCI.[42]

Pressure relief surfaces. In addition to pressure relief maneuvers, pressure relief surfaces also has a large role in preventing pressure ulceration. In her follow-up study of individuals with SCI in Nepal, Scovil *et al.*'s[28] participants were given cushion-less wheelchairs and 'all but one were using wheelchair cushions made of poor-quality locally available foam with vinyl covers'. Most study participants spent the majority of their time in bed where pressure relief surfaces were also suboptimal: 'Two had no mattresses on wooden bed frames; the rest had mattresses made of locally available foam or cotton materials'.[28] Although these conditions are less than ideal when compared with cushions and mattresses in the developed world, even simple pressure relief surfaces are more effective than nothing at all. Several recent studies have shown that very low-cost pressure relief surfaces can have a large impact in reducing PU incidence and severity. Nwadinigwe *et al.*[68] showed that water mattresses decreased the incidence and magnitude of PUs, thus decreasing hospital length of stay in a Nigerian Hospital. In Malaysia, Ooi and Julia[69] have shown that the inner tube of a Vespa scooter costing US$4 is a useful wheelchair cushion whereas Guimaraes and Mann[70] created the cheap (US$6), durable and effective 'Tuball' cushion from bicycle inner tubes and plastic balls for use in Brazil. Medical equipment intended for developing nations must be inexpensive, practical, durable and easily repairable.[4] Furthermore, such equipment must be tailored to the context of the developing nation in question and users be trained on the proper use of the device. As exemplified by Raissi *et al.*[24] in an Iranian study, even if SCI patients are supplied with pressure relief equipment at zero cost, these supplies are futile if not used or improperly used: 'Most of the patients did not use their beds because of inappropriate height, the quality of the beds, and living habits. Few of the patients who used the Roho cushions knew how to inflate the cushion appropriately; the pressure was usually high'.

Education. Perhaps the most important ingredient for the prevention and management of PUs is education. The goal of improving education applies not only to the patient but also to the patient's physician, nurse, therapist, family and community. In order to live successfully with SCI, individuals need to understand the possible complications of their condition, a knowledge base that often begins in rehabilitation centers. Unfortunately, in many developing nations, specialized rehabilitation centers with trained rehabilitation personnel are very rare.[2,41] After the 2005 Earthquake in Pakistan, Rathore *et al.*[8] noted fewer complications such as PUs among those with SCI when specifically treated by rehabilitation specialists, a finding that has been well-established in the developed world.[71] Even without dedicated rehabilitation centers, all medical personnel who interact with SCI patients should have at least a basic understanding of SCI management, ideally learned in medical and nursing school.

Improving SCI education in the developing world is no simple task however. First, in regions of the world plagued by rampant infectious disease, poverty and/or civil unrest, care of the disabled simply falls beyond the capacity of limited healthcare resources. Second, the multitude of languages and dialects, a poor understanding of human anatomy and physiology, and devastatingly low literacy rates in many developing nations makes dissemination of knowledge challenging.[8] Finally, care providers, and especially international aid organizations, need to understand and operate within the context of their patients' lives. In a comparative analysis of people living with SCI in 14 countries representing all WHO world regions (Thailand, India, Vietnam, Malaysia, Denmark, Germany, Switzerland, New Zealand, Australia, Israel, USA, Canada, Brazil and South Africa), Reinhardt *et al.*[72] noted, 'health professionals know only little about the environment of their patient,' a situation likely to breed unrealistic expectations of how one is to care for oneself once living at home. Indeed, even if 'first-world' care is provided to a patient in the hospital, these efforts will go to waste if the necessary care cannot be continued after discharge.[13] In other words, hospital and rehabilitation treatment strategies must be tailored to a patient's outpatient world.

Finally, the notion of education is also paramount as it applies to public awareness and dissolution of social stigmas. Community reintegration and peer support are pivotal components of success after SCI and are known to be associated with decreased rates of PUs and other SCI-related complications in the developed and developing world alike.[28,40] Unfortunately, both environmental and psychosocial barriers impede community participation. In Iran, individuals with SCI report social isolation and feelings of being pitied.[9] In Pakistan, disabled persons are often concealed in the home because disability is believed to bring guilt and shame upon a family.[41,42] Such situations may foster depression and limit motivation towards self-care. Indeed, psychological comorbidities such as depression and anxiety themselves may foster PU development.[40] In the end, more than ramps and wheelchair-accessible buildings are necessary to decrease

complications associated with poor community accessibility; community integration will also require improved societal understanding of SCI.

CONCLUSIONS AND FUTURE DIRECTIONS

The preceding discussion supports the hypothesis that PUs are more difficult to prevent and treat in developing nations where the risk factors for PUs such as poverty, low education, limited activity level and malnutrition, are more prevalent. That said, this discussion also suggests that PU rates in the developing world can be decreased with improved acute care, adequate nursing, improved support surfaces and education.

In order to decrease the incidence of PUs in developing countries, we first need to understand the actual weight of the burden. There is currently little data on the true prevalence or cost of PUs in many regions of the developing world, regions where we expect the burden to be particularly high. Fortunately, organizations such as the International Spinal Cord Society have established data sets that could be used to standardize international data collection on PUs.[73] Even with these data collection templates, however, harvesting information will be a challenge in hospitals and clinics with vast catchment areas connected by poor roads, lack of electronic records and few if any rehabilitation specialists.

Irrespective of the true statistics, there are clear targets for improving PU prevention and management and for SCI care more generally. Perhaps the most obvious deficiency highlighted here is that of dedicated rehabilitation centers and trained rehabilitation providers. Although there has been some progress in bringing rehabilitation strategies to the developing world, there is still a lack of rehabilitation medicine in many remote or impoverished regions. Tackling this deficit will be challenging. A first step towards the naissance of dedicated rehabilitation centers and providers is education. To this aim, a recent initiative by the International Spinal Cord Injury Society and other collaborating partners has developed a wide range of electronic learning modules for SCI available at no charge over the Internet (http://www.elearnsci.org). In addition, there are a variety of other useful online resources such as the Spinal Cord Injury Rehabilitation Evidence project (scireproject.com) and the Paralyzed Veterans of America Consortium for Spinal Cord Injury Clinical Practice Guidelines (http://www.pva.org), to name only a few.

Although affordable and durable medical devices for PU management do exist, further research in this area is needed. Importantly, these devices must fit within the context of the patient's environment, and patient and caregiver training with such devices is essential. Finally, public awareness campaigns are needed to minimize risk factors for PUs, to promote community integration, and to empower people with disabilities.

In many ways, management of SCI in developing countries is a unique opportunity to improve SCI care throughout the world. It is an opportunity to build on years of experience in developed nations whereas also breaking new ground. Who knows what might be discovered when a system of care is rebuilt in a different clime, with fresh insight.

Finally, though uncomfortable, it is necessary to ask the difficult question—is it worth it? In world regions where healthcare resources are slim and public health issues like infectious disease, malnutrition and fetal and maternal health have a much larger societal impact, should communities invest in improving SCI outcomes? The authors would like to suggest that the answer to this question is indisputably yes. For those who are willing to reach out beyond the borders of the developed world, there are many patients, families, providers and communities eager to learn, to heal and to thrive.

DATA ARCHIVING

There were no data to deposit.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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