Spinal Cord Injury network

13 August SYDNEY

CONNECTIONS 2012

from research to community

Bayside Grand Hall
Sydney Convention and Exhibition Centre
Darling Harbour

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Conference Abstracts

"I want to knock down the barriers to spinal cord injury research... **nothing is impossible**"

– Christopher Reeve
Actor, Director, Author

Introduction from the NSW Government

In 2003 more than 1000 people attended the *Making Connections: NSW Premier's Forum* at Sydney's Convention and Exhibition Centre in Darling Harbour.

The participation of the late actor Christopher Reeve in that Forum was instrumental in laying the foundation for NSW becoming an international centre for excellence in research into spinal cord injury (SCI) and other neurological conditions.

It is therefore particularly fitting that a Keynote Speaker for the third SCI *Connections* Conference should be Christopher's son, Matthew Reeve, who in addition to being an awarded filmmaker is also on the Board of Directors of the Christopher and Dana Reeve Foundation, helping to improve the quality of life of those living with SCI.

Christopher Reeve was charismatic and personable, and made a profound impression on everyone who was privileged to meet and spend time with him. It was a direct result of his participation in *Making Connections* that led the NSW Government to commit $35.9 million over four years (2003-2007) on research and extra services for people with spinal and physical disabilities.

Of this sum $10.9m was allocated to the NSW SCI and Related Neurological Conditions Fund to promote research into SCI and other neurological conditions. Since then the NSW Government has continued this commitment allocating $11.2m in 2007 and a further $2.9m in 2011.

This means a total $25m over eight years has been allocated by the NSW Government to research into SCI and other neurological conditions – the single largest research amount allocated to a specific medical condition administered by the Office for Health and Medical Research on behalf of the NSW Government.

To date 23 researchers have been funded under the Spinal program, with some outstanding results:

- 169 articles have been published in peer reviewed journals with numerous manuscripts submitted and in preparation
- 2 books have been published as well as 13 chapters in other books
- 261 national and international presentations have been made at both medical and community focussed conferences like these
- 78 national and international collaborations have been entered into
- 58 Honours and PhD students have been trained to cultivate the next generation of SCI researchers
- And 35 Postdoctoral Fellows have been mentored.

Research of course is only one component of the many medical, hospital, rehabilitation and care services provided by the NSW Government to assist those with spinal and other neurological conditions to have the highest possible quality of life.

The Government has also provided $1.9m in funding since 2008 to support the Spinal Cord Injury Network and its important initiatives including developing a spinal research data linkages program, a clinical trial coordination strategy, and a research capacity building strategy.

The *Connections* Conferences have proved effective forums for those who have spinal and other neurological conditions to exchange information and experiences with those who provide support services and undertake research in the area. The Government is determined to make this engagement between those needing health services, those providing them, and those undertaking research into these health areas a policy priority. Towards this end, this year's conference includes not only reports on the most promising research developments in SCI and other neurological conditions research. It will also provide a strategic workshop on developing a research roadmap for future research and a community forum where we are seeking the SCI community's perspective on the research you consider important.

I would like to commend the Spinal Cord Injury Network on its organisation of this third iteration of the *Connections* forum and am pleased that NSW Health is the principal sponsor for *Connections 2012*.

Dr Antonio Penna
Director, Office for Health and Medical Research
NSW Ministry of Health
August 2012

Welcome Message

It is a great pleasure to welcome you to *Connections 2012*. This meeting with the theme "From research to community" brings together researchers, healthcare professionals, the community, policy makers and other key stakeholders in a unique forum to discuss spinal cord injury (SCI) research in Australia, New Zealand and internationally.

Health and medical research is a shared responsibility. From researchers, clinicians and the community, through to Government, industry and philanthropy, we all have our part to play. The Spinal Cord Injury Network connects a diverse stakeholder base with many different perspectives. However, forming a united front on key issues is imperative in building a case for advocacy and facilitating progress that will make a difference. Together we can build strength and capacities that derive from synergy.

The *Connections 2012* program takes a broad look at some of the key research areas and issues in SCI research today. Progress in cellular therapies, rehabilitation, exercise and pain research will be reviewed. The challenges of working in partnership, conducting clinical trials, engaging clinicians in research and enhancing the national SCI registry will also be discussed. International experts will be able to provide insights on working within multi centre networks. A Community Forum provides an opportunity for our community to learn more about the health and medical issues that relate directly to them. We also hope it will allow our community to have their say on research priorities.

Connections 2012 goes beyond the exchange of knowledge and ideas. A key aim of the meeting is to gain input from all our stakeholders on how the Spinal Cord Injury Network can facilitate research in Australia and New Zealand. We want your input on how we can maximise Australia and New Zealand's role in the global research effort. There is already a significant and often collaborative effort in working towards better health outcomes for people with SCI. Now is the time to join together and build on the current investment, galvanising our efforts into the future. The success of this meeting will be due to the invaluable support of our distinguished speakers, our generous sponsors, and not least you for being a part of *Connections 2012*.

We trust you will enjoy the meeting and a very warm welcome to Sydney.

Dr Stephanie Williams
Chief Executive Officer
The Spinal Cord Injury Network
August 2012

Connections 2012 Awards

The Spinal Cord Injury Network is pleased to support the attendance of the following individuals at *Connections 2012*. Our congratulations and best wishes to all *Connections 2012 Award* winners for a successful and enjoyable meeting.

Dr Carolyn Beaver (Burwood Academy of Independent Living, Christchurch, New Zealand)

I sustained a spinal cord injury (SCI) in 2006 while working as a veterinary surgeon in the UK. I am currently completing a Postgraduate Diploma in Rehabilitation through the Rehabilitation Teaching and Research Unit at the University of Otago. The *Connections* conference would be a brilliant opportunity to collaborate with other people involved in the area of SCI research. The program includes many topics, which are of interest to me and would also facilitate further learning and development of my knowledge in this area.

Perry Cross (Perry Cross Foundation, Gold Coast, Queensland)

The Foundation [We] would love to learn more about other opportunities available and the plans for research in the future in Australia and overseas, and feel *Connections 2012* will give us this opportunity. We also believe it would be an ideal networking opportunity for all of us to connect as part of the SCI Community in Australia.

Beatriz IR de Oliveira (Curtin University, Perth, Western Australia)

I am a PhD student at Curtin University and perform studies within the Spinal Cord Injury Physical Activity (SCIPA) program. Participation in this conference will be of great value for me as an international student to improve my network with professionals who work in this field and be aware of the latest findings in SCI. This is an excellent opportunity to engage various allied health professionals in our program and reach out to more people with SCI.

Sharron Neeson (ParaQuad SA, Adelalide, South Australia)

As the Manager of Support Services for Paraquad SA, I have been given the responsibility of becoming informed about current research opportunities in SCI and disseminating this information to our clients and their families as well as colleagues and sponsors. *Connections 2012* provides a significant opportunity for me to learn more about the future of SCI research in Australia, and I look forward particularly to discussions around pain and exercise in relation to SCI.

Dr Olivia Ong (Walk On Melbourne, Victoria)

I am currently a medical doctor training to be a rehabilitation physician in the field of SCI rehabilitation in Melbourne. As an individual who has been inflicted with a SCI, I am keen to attend this conference to improve my short term and long-term quality of life, and also network with other individuals with SCI, with the belief and hope that my story inspires them and their stories in turn will inspire me to persevere for the long haul.

Clayton Rumble (Canberra, ACT)

I am a paraplegic caused by a sleepwalking fall in 2007. I suffer extreme neuropathic pain. I am interested in learning more about recent advances in research for a cure for SCI, the status of current and future clinical trials... I am particularly interested in the talk by Professor Philip Siddall on "Where are we going with pain treatments?"

Jonathan Tang (Brisbane, Queensland)

My injury was sustained whilst I was studying medicine at the University of Sydney. I previously worked as a physiotherapist in a large public hospital. This will be my first conference since the injury. As a person with SCI I have experienced the positive and negative aspects of rehabilitation. My clinical knowledge has given me a unique skill to thoroughly articulate my symptoms and problem solve with my treating team to identify the most effective way to approach new challenges. It would be a pleasure to share my experiences with other researchers in this field.

Raelene West (Melbourne, Victoria)

I have a SCI myself… I feel both the [previous] *Connections* forums provided a unique opportunity to bring together a cross range of people involved in SCI to meet and discuss the current landscape, situation and issues of people with SCI… Further, I am now involved myself in research associated with SCI on the provision of disability services. Attending the conference in Sydney would provide an opportunity for me to hear about some of the experiences of receiving disability services and compensation by people in NSW with a SCI and give me an opportunity to compare and contrast issues. *Connections 2012* would provide me with an opportunity to again be a part of this unique forum and the current discussion in Australia and internationally on improving the quality of life for people with SCI.

Connections 2012 Program

8.00 am	Registration opens

Conference Opening and Welcome

8.30 am	Welcome to Country, Michael West
8.40 am	The Hon Jillian Skinner MP, Minister for Health, Minister for Medical Research
8.50 am	Dr Stephanie Williams, Chief Executive Officer, Spinal Cord Injury Network

Keynote Presentations

9.00 am	Reaching our common goals: The importance of collaboration in providing today's care and finding tomorrow's cure Matthew Reeve Member of the Board of Directors, Christopher & Dana Reeve Foundation
9.30 am	Cellular therapy for spinal cord injury Dr James Guest Miami Project to Cure Paralysis / Miller School of Medicine
10.00 am	Neuroplasticity after spinal cord injury Emeritus Professor Volker Dietz Spinal Cord Injury Center, Balgrist University Hospital
10.30 am	Morning Tea

Strategic Workshop: Developing a Road Map for the Future

11.00 am	Engaging clinicians in research Dr David Berlowitz Institute for Breathing and Sleep, Austin Health / University of Melbourne
11.20 am	Can we do better with clinical trials Down Under? Professor Sarah Dunlop, University of Western Australia
11.40 am	Joining the dots: Linking clinical and research data to really make a difference Cameron Gosling, Monash University
12.00 pm	Right care, right time, right place: Working in partnership to improve outcomes Associate Professor James Middleton, NSW State Spinal Cord Injury Service
12.20 pm	Panel Discussion
1.00 pm	Lunch
1.30 pm	Registration for Community Forum

Community Forum

2.00 pm	Welcome Dr Stephanie Williams, Chief Executive Officer, Spinal Cord Injury Network
2.05 pm	Interview with Matthew Reeve* and Catriona Williams** *Member of the Board of Directors, Christopher & Dana Reeve Foundation **Founder, CatWalk Trust, New Zealand; Director, Spinal Cord Injury Network

Presentations on Community FAQ's

2.30 pm	If you could...? Priorities of people with spinal cord injury Dr Kathryn Nicholson Perry, University of Western Sydney
2.45 pm	Will stem cells deliver on their promise? Dr James Guest, Miami Project to Cure Paralysis / Miller School of Medicine
3.00 pm	Where are we going with pain treatments? Associate Professor Philip Siddall, University of Sydney
3.15 pm	Does exercise really matter? Professor Mary Galea, The University of Melbourne and Austin Health
3.30 pm	"Ask the Expert" Session
4.30 pm	Wrap Up
4.45 pm	Mixer
6.00 pm	Close

Cellular therapy for spinal cord injury

Dr James Guest

Miami Project to Cure Paralysis and Miller School of Medicine, Florida, USA

The spinal cord is an exquisitely complex tissue consisting of cellular control circuits and transmission wires. These cells provide insulation, metabolic and structural support, and surface lining. All of these cellular components are irreversibly lost to varying degrees at the site of spinal cord injury (SCI). To a limited extent some of the lost cells are replaced after SCI but repair is often insufficient to lead to useful recovery of neurological function. For this reason, transplantation of cells or tissues to augment repair of the damaged spinal cord has been studied intensively for 30 years. The cell types transplanted are targeted to repair the signal conducting axons through regeneration and reconnection, or to repair the myelin coating that enables conduction, or to diminish the scar that obstructs regenerative growth.

Although there is only a single injury epicenter, changes that occur throughout the entire central nervous system (CNS) after SCI must be considered in repair strategies. The cell and tissue types that have been tested in SCI repair experiments include nerves [9], fetal CNS tissue [13], nerve-supporting cells- oligodendrocytes [5], Schwann cells [4], olfactory ensheathing glia [2,7], and astrocytes [1]. Non-nervous system cells such as macrophages [6], bone marrow cells, umbilical cord cells, and others have also been tested for their repair potential.

Repair experiments have been applied to acute, subacute, and chronic SCI including complete spinal cord interruption, and partial injuries of varying severities. Although many experiments have led to encouraging results, in some instances, other scientists were unable to reproduce the favorable results [12]. This makes progress towards clinical application more tedious because the repair effect should be sufficiently robust and reproducible before putting people at risk. Conceptually, the repair transplants are aimed to either replace lost cells or support regeneration of remaining nerve fiber processes. None of the cells or tissues alone can provide comprehensive repair, though for a few years it was considered that embryonic stem cells (ESC) could do this. This is because the injury area has insufficient instructive signals to direct the correct differentiation and integration of ESC, and without this control they can form tumors. Thus, ESC must be partly differentiated in cell culture to become one particular cell type before transplantation, restricting their potential but rendering them safer [10].

One of the safest possible cell types to transplant after SCI are Schwann cells (SC). SC support regeneration of peripheral nerves after injury unlike the response in the CNS. SC are not stem cells because they can only form other SC through cell division. They can be grown from a small nerve taken from the leg and transplanted into the damaged spinal cord after being purified in cell culture. We know that SC spontaneously enter the damaged spinal cord after SCI in most people [3] with no apparent adverse consequences, thus increasing our assurance that their transplantation should be safe. After purified SC are transplanted into the spinal cord they can reduce tissue loss, repair damaged myelin insulation, create tissue bridges for CNS nerve fiber regeneration [4] and reduce the size of damage cavities. Furthermore, because they are derived from the same person to whom they are subsequently transplanted, suppression of an immune system rejection response is not necessary. SC have undergone extensive experimental testing and their safety and efficacy has been independently verified [11]. In addition, the cells can be altered genetically to make them even more effective or transplanted as part of a combinatorial treatment [8]. It will likely be necessary to utilize combined treatments to obtain substantial repair after SCI. SC transplantation is now poised to commence in research subjects with subacute SCI. After informed consent a small nerve will be harvested within 5 days of injury and the SC purified during a rigorous manufacturing process that takes 2-3 weeks. At that point the SC will be directly injected into the SCI epicenter.

In summary, cellular repair is essential to reconstruct the spinal cord and several cell types have been tested. The generation of knowledge that leads to highly effective treatments requires robust preclinical data and rigorously designed clinical trials. Premature testing in humans without these elements leads to resource waste and may cause discouragement.

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Neuroplasticity after a spinal cord injury

Emeritus Professor Volker Dietz

Spinal Cord Injury Center, Balgrist University Hospital, Zurich, Switzerland

After a spinal cord injury (SCI) of the cat or rat, neuronal centers below the level of lesion exhibit plasticity that can be exploited by specific training paradigms. In individuals with complete or incomplete SCI, human spinal locomotor centers can be activated and modulated by locomotor training (facilitating stepping movements of the legs using body weight support on a treadmill to provide appropriate sensory cues) (for review see Dietz 2002, 2003). Individuals with incomplete SCI benefit from locomotor training such that they improve their ability to walk over ground. Load- or hip joint-related afferent input seems to be of crucial importance for both the generation of a locomotor pattern and the effectiveness of the training (Dietz et al. 2002). However, it may be a critical combination of afferent signals that is needed to generate a locomotor pattern after severe SCI. Mobility of individuals after a SCI can be improved by taking advantage of the plasticity of the central nervous system and can be maintained with persistent locomotor activity. In the future, if regeneration approaches can successfully be applied in human SCI, even individuals with complete SCI may recover walking ability with locomotor training (Curt et al. 2004).

During the past few years, several approaches to spinal cord repair have been successfully established in animal models. For their use in clinical trials of SCI in human beings, specific difficulties that affect the success of clinical trials have to be recognised (Dietz and Curt 2006). First, transection of the spinal cord is commonly applied in animal models, whereas contusion, which generally leads to injury in two to three segments, represents the typical injury mechanism in human beings. Second, the quadrupedal organisation of locomotion in animals and the more complex autonomic functions in human beings, challenge translation of animal behaviour into recovery from SCI in people. Third, the extensive damage of motor neurons and roots associated with spinal cord contusion is little addressed in current translation studies. Fourth, there is increasing evidence for a degradation of neuronal function below the level of the lesion in chronic complete SCI (Dietz and Müller 2004; Dietz et al. 2011; Dietz 2010). This degradation might have a considerable impact in chronic SCI subjects for a regeneration-inducing treatment. Therefore, its relevance needs to be investigated. As a basis for repair interventions a multi center network was built up (EM-SCI) using the same assessments over the course of rehabilitation and to serve as a basis to perform interventional studies (Curt et al. 2004).

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Engaging clinicians in research

Dr David Berlowitz

Institute for Breathing and Sleep and Department of Respiratory and Sleep Medicine, Austin Health, University of Melbourne

Clinical research can be stimulating, difficult, satisfying, demoralising and all of the above, often at almost the same time. Clinical care of patients is also all of these things, but for people from a health professional background (medical, allied health or nursing), clinical practice is typically better paid and employment more secure when compared with a life in research. Despite this, many of us with a health professional background make a move out of a predominantly clinical role into a scientific one. In this presentation, we will discuss:

- Why clinicians should consider a research, or part-research career
- What resources (physical, financial and personnel) might be required to enable this, and
- How one might go about finding these resources.

A strong evidence base is considered essential for exemplary clinical care. However, the literature to support our practice is often hampered by too few trials in too few people. There is little level 1 evidence to support the participation of clinicians in research, however as observed with the use of parachutes as a gravity counter-measure [1] this has not hindered widespread uptake of this model. In my opinion, clinicians bring unique perspectives to all stages of research. These include the intuitive identification of clinical problems, a context in which the emergent hypotheses can be tested, particular skills in data collection, analysis and interpretation and insights into the steps necessary for effective translation of novel findings into practice. However, just because an individual has clinical expertise, there is no reason to believe that research excellence (or even competence) will follow. Only by working in partnership with the people who really know what they are doing, the career scientists, can the full potential of any clinician researcher be realised.

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Can we do better with clinical trials Down Under?

Professor Sarah Dunlop

Experimental and Regenerative Neurosciences, School of Animal Biology, The University of Western Australia

The current situation in Australia: Spinal units in Australia and New Zealand are becoming increasingly involved in clinical trials, a situation reflecting strategic increases in research funding, especially in NSW and Victoria. A search of the Australia and New Zealand Clinical Trials Registry www.anzctr.org.au for "traumatic spinal cord injury" (SCI) and "Australia", together with knowledge of other currently funded or proposed trials, revealed 16 that are open for recruitment, 2 terminated and 4 completed. After making approximate corrections for patients recruited from international sites, currently open trials involve an estimated 1,061 patients, a value approximately 4x (3.88) the number of incident cases of spinal cord injury in Australia (n = 273, Access Economics, 2009); however, the trials have start dates spanning 2008-2011 thereby decreasing this discrepancy. Half (8) the open trials are recruiting in the chronic (> 6 months) phase and 4 are recruiting between 6 weeks to 6 months; sub-acute trials (3) involve patients between 24h and 6 weeks and one proposed trial aims to recruit within 1.5 hours. Interventions primarily involve exercise, assistive devices and electrical stimulation/FES with one involving probiotics and another a novel drug (ghrelin). Of the open trials on ANZCTR (10), 6 involve 14-32 patients and the remainder (4) 78-372, all being multicentre.

The current situation internationally: To put Australia's contribution in context, a search of http://clinicaltrials.gov/ for "spinal cord injury, open studies, studies without results and interventional studies" and of China SCI Net http://www.chinascinet.org/ revealed, not surprisingly, over 100 trials with a broader range of interventions than those being investigated in Australia. Trials involve diet (1), surgery (2), vibration (2), procedures (2), intermittent hypoxia (2), devices without stimulation (3), behaviour/education (10), stem cells (12), devices with stimulation (19), exercise/movement (23) and drugs (32). Drugs are wide-ranging and target blood pressure, faecal incontinence, fatigue, osteoporosis, pain, pulmonary function, spasticity and urinary tract infections. A smaller number of biologically-based therapies targeted at the acute phase (<12h to < 7 days) aim to prevent growth cone collapse (Cethrin), block myelin inhibitory molecules (AT1355) or block TTX-sensitive sodium-channels (Riluzole).

Can we do better Down Under? I think we would all agree that we can, the question is how? We would also agree that better treatments, especially in the acute phase, are urgently needed for SCI patients. Australia has an emerging track record in SCI clinical trials with NSW and Victoria as the main hubs. However, to maximise our effectiveness, Australia should 1) establish a national strategy to examine the balance between small, single investigator and large multicentre studies and thereby decide which trials to conduct, 2) establish a mechanism to coordinate recruitment between trials, such as occurs in Victoria, thus ensuring success of all trials rather than success of some at the expense of others, 3) leverage funding in NSW and Victoria to lobby for increased funding in Queensland, South Australia and Western Australia, 4) build research culture in all spinal units through training and undertaking multicentre trials. The patient is foremost and development of successful treatments will depend on buy-in from all sites and will require effective networking and communication, strong administrative support and adequate funding.

Joining the dots: Linking clinical and research data to really make a difference

Cameron Gosling
Department of Epidemiology and Preventive Medicine, Monash University

Clinical data collection involves the routine recording of patient information for the purpose of observing and treating patients; while research data is information collected with the express purpose of gaining knowledge, understanding and insight for a specified question. Patient information must be epidemiologically sound and collected systematically if it is to be useful as research data. It is not just a matter of linking data, as the quality of the data collected will ultimately determine its utility as research information.

Quality clinical registries provide an ideal vehicle to utilise routinely collected clinical and hospital administrative data for research. Improvement in the quality and safety of health care provision, regardless of the medical specialisation, can be achieved through routine monitoring. Registries are a platform for assessing the efficacy of health care providers and systems, interventions, medications and devices. Monitoring should include long-term follow-up of patient outcomes, not just information pertinent to the acute episode of care.

For registries to be effective research tools, standardised data definitions and collection methodologies should be employed. Registries should be routinely audited for outcomes of interest, have the capacity to link with other data sources, use standard patient data collection processes, and engage clinicians and key stakeholders. Effectively collected information allows clinicians to benchmark patient outcomes against clinical standards or other desired outcomes. However, data collection alone does not make an effective clinical registry. Data must then be analysed and disseminated to key stakeholders before the utility of the registry can be judged.

Clinical registries generally provide a versatile medium to provide: population-based long-term monitoring of outcome changes over time or following specific interventions. They provide an information source when randomised controlled trials are not feasible or are unethical. However, the benefit of registries comes at a cost. Barriers to effective clinical registries include their expense, potential for human error, the need for extensive personnel and infrastructure resources and the on-going nature of these commitments. The key to an effective registry, like any research project, is good planning. Planning should include engagement of all stakeholders, establishment of a clear justification for the registry, a realistic assessment of available resources and funding requirements, and formalisation of governance structures.

Clinical data provides a rich source of information to assist in theory generation and hypothesis testing. The challenge is to determine what is collected, how that data is used to understand the current clinical environment, and how changes in clinical practice can be made where warranted.

Right care, right time, right place: Working in partnership to improve outcomes following traumatic spinal cord injury

Associate Professor James W Middleton

Director, State Spinal Cord Injury Service, NSW Agency for Clinical Innovation & Rehabilitation Studies Unit, Northern Clinical School, Sydney Medical School, The University of Sydney

Whilst primary injury prevention of spinal cord injury (SCI) is ideal, this cannot always be achieved. It has long has been recognised that some injuries of the spinal column put the cord at risk of injury, without cord injury necessarily occurring. Spinal precautions are intended as secondary prevention, to avoid or minimise cord damage where there is vertebral instability. More recently, it has been recognised that management after acute SCI is time-sensitive, with rapid access to specialist care being critical [1] not only to enhance preservation (neuroprotection) and possible recovery of neurological function through early neurosurgical decompression [2] and emerging translational therapies [3] but also to prevent secondary complications [4] that can be fatal, delay or impede rehabilitation and adversely affect long-term outcomes. There is, however, a lack of outcome data on the size and nature of the effect of delayed commencement of specialised SCI care, and on the influence of other factors in the early period after SCI onset.

Optimal treatment and outcome will depend on having an effective and coordinated health care system, reinforcing the need for rapid case identification and transport, treating all suspected SCI patients as medical emergencies, and earliest possible transfer to specialised care in SCI Units. Until now, no study of access to care for patients with SCI has been undertaken in Australia, examining the effects of time-to-care, vital decision-making steps in the early care pathway and other factors on short and long-term outcomes of traumatic SCI.

"Right care, right time, right place" is a funded NHMRC Partnership Project with collaboration between key stakeholders involved in the provision, funding, policy development and research of health services for persons with SCI in NSW, South Australia and Victoria. Data collection will occur in NSW and Victoria, states in which there are trauma management systems and trauma data collections, in collaboration with the National Injury Surveillance Unit in Adelaide. It comprises a larger sample of 'suspected' SCI patients in each state, and a smaller 'nested' group of those confirmed with SCI diagnosis. By linking ambulance data with hospital records and then through routine follow-up, we will access information across all parts of the patient's journey to, through and after definitive care.

The study aligns with the National Health Hospital Reform Commission's priority to develop a national performance framework and clinical registries [5] supporting redevelopment of the Australian Spinal Cord Injury Registry and 'proof-of-concept' of capability to capture information across care interfaces, in areas associated with variations in processes or outcomes of care impacting significantly on health care costs and patient morbidity. The project will lead to streamlined, effective treatment pathways supported by evidence-based guidelines to optimise care and outcomes in patients with acute traumatic SCI. This project demands the collaboration of at least 12 key groups across sectors and states working in partnership, with good communication and coordination being key factors for success.

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If you could...? Priorities of people with spinal cord injury

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Approximately 9,000 people are presently living with spinal cord injury (SCI) in Australia, with the annual cost being estimated at $AU2 billion (Access Economics, 2009; Cripps, 2008). Improving function following injury is likely to both improve the quality of life of the person with SCI and their significant others, as well as reduce costs to individuals and the community. There is an increasing emphasis on including those affected by a condition in decision making relating to both the management of relevant services and the setting of policy and research agendas. Some evidence from a survey of people with SCI in North America is available to inform these decisions, but only limited information is available from Australasia (Anderson, 2004; Tran, Craig, Wijesuriya, & Middleton, 2009). The current study replicated the previous surveys, extending the sample of the previous Australian study across Australia and New Zealand. The link to the survey was distributed through the Spinal Cord Injury Network via partners in Australia (n = 182, 92%) and New Zealand (n = 8, 4%). 203 respondents took part in the study from Australia (n = 182, 92%) and New Zealand (n = 8, 4%), with 199 completing it (males = 129, 65%; mean age = 46.5 years, SD = 13,2; tetraplegia = 105, 53%; mean duration of injury = 16.9 years, SD = 13.7). Participants were asked to rank in order of priority what gain of function would dramatically improve their life: arm / hand function, upper body / trunk strength and balance, bladder and bowel function, sexual function, elimination of chronic pain, normal sensation, walking movement, elimination of autonomic dysfunction and other. Overall, bladder and bowel function was most frequently rated as most important (34%), followed by walking movement (19%) and arm and hand function (18%). When divided into those with tetraplegia and paraplegia, those with tetraplegia most frequently ranked arm and hand function and bladder and bowel function as most important (both 30%), followed by walking movement (17%) whereas for those with paraplegia, bladder and bowel function was most commonly rated as most important (39%), followed by walking movement (22%) and elimination of chronic pain (14%). The findings in the current sample were markedly different from both the prior North American and Australian studies. This may be related to the different context from which previous samples were drawn. The implications of the findings for funding of research will be discussed.

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Will stem cells deliver on their promise?

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The discovery of stem cells in the adult nervous system and the development of technologies for their propagation created hope they could be used to improve neurological function after spinal cord injury (SCI). We can characterize the "promise" of stem cells to be unprecedented potential for nervous system repair and renewal. In fact, we have learned that some stem cell mediated repair occurs naturally after SCI [8]. However, 20 years beyond the seminal discoveries [6] we realize that the achievement of great success with stem cells in SCI is still limited by several issues. It was hoped that we just inject stem cells into a region of spinal cord injury (SCI) and they would rebuild the spinal cord effectively. However, that has not yet happened for a number of reasons.

One key limitation is the lack of instructive signals in the injury environment. The tissue is so disrupted that signals to cause stem cells to undergo the necessary differentiation steps to rebuild the tissue and form connections is lacking. An exception to this is axonal demyelination where embryonic stem cells that are partially pre-differentiated have been shown to engage the damaged axons and form new myelin [5]. Promising experimental data regarding creating new neuronal relay circuits in the spinal cord using transplanted stem cells are emerging [2].

Because reconstruction of the central nervous system is so complex, it is sensible that initial successes in the medical application of stem cells would be with simpler problems such as cell replacement in tissues such as heart muscle where trials are ongoing. Diseases of the retina offer the advantage that the effects of the stem cell transplant can be directly observed using ocular imaging [7]. Such imaging does not yet exist to study post-transplantation events in the spinal cord.

Cell transplants are not reversible and have potentially serious risks. The most serious risk ascribed to stem cell therapy is the formation of tumors but other problems such as triggering an immunological reaction can occur. The optimal duration and intensity of immune suppression required after allogeneic stem cell transplantation has not been determined.

As shown by the recent collapse of the Geron clinical trial, market and cost factors limit progress in stem cell medicine [3]. SCI is a relatively uncommon condition and companies may not invest in a stem cell technology unless it has broader applicability. A promising development is a state effort, CIRM, the California Institute of Regenerative Medicine, that awards large "disease team grants" to fund stem cell research with a rapid time line for progress into clinical testing.

Some entrepreneurs have abused the promise of stem cells by transplanting uncharacterised cells outside of clinical trials and profiting from the hope of persons with SCI [1]. Fortunately, high quality trials have been initiated testing neural stem cell transplantation in amyotrophic lateral sclerosis [4] (Neuralstem) and in subjects with chronic SCI (Stem cells Inc.).

In conclusion there has been relatively rapid progress in stem cell medicine and clinical translation has been initiated.

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Where are we going with pain treatments?

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Pain is a major problem for many people with a spinal cord injury (SCI). Not only is pain very common, but it also has a major impact on the person with pain. Around one third of people rate their pain as severe and the pain almost always has a flow on effect with an impact on mood and physical function. There are three very broad types of pain commonly associated with (SCI): musculoskeletal pain, visceral pain and neuropathic pain. Each of these types of pain requires different approaches to treatment [1].

Musculoskeletal pain is treated like most other musculoskeletal pain conditions although there are specific features and needs in people with SCI. Treatments include medications such as analgesics, anti-spasm medications and anti-inflammatory medications and physical approaches such as physiotherapy, occupational therapy and exercise programs. Musculoskeletal pain may also require attention to issues such as wheelchair use, posture and seating. Visceral pain usually requires attention to problems such as bladder infections, kidney stones or bowel obstruction.

Neuropathic pain is the most difficult type of pain to treat. There are a large number of treatments that are used with varying degrees of success [2]. However, the best pharmacological treatments provide satisfactory relief of pain in only a minority of people with pain. In addition, strong evidence is limited with only a few well-designed studies with large numbers of subjects. Treatment selection is therefore often based on evidence from studies in other neuropathic pain conditions. The main pharmacological treatments include anticonvulsants, antidepressants and opioid medications. However, many of these drugs provide only partial benefit and often produce unwanted side effects.

As a result, non-pharmacological treatments such as cognitive behavioural therapy are used to assist people with pain. However, this is often aimed more at managing the pain than relieving it. Techniques such as spinal drug administration and stimulation techniques are effective in some people but may require invasive procedures. There has also been recent interest in non-invasive, non-pharmacological approaches such as imagined movements, visual illusions and non-invasive brain stimulation. These may be exciting options for the future.

At present, it is often difficult to get effective relief of pain in people with a SCI. However, there is reason to hope that this will improve in the near future. There is now increased understanding of how the brain and spinal cord react to SCI and cause pain. There is also intense interest in developing new pharmacological and non-pharmacological approaches that may help people with pain. Hopefully, it won't be long before we see some of this interest and work translate into better options for treating pain.

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Does exercise really matter?

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Spinal cord injury (SCI) is an extreme example of deconditioning or movement deprivation, which has profound effects on the neuromusculoskeletal system. Muscle fibre atropy occurs quite rapidly after SCI, and loss of normal muscle forces contributes to bone demineralisation, which follows a rate of exponential decay. Adaptations to disuse also occur in the circulatory system, with reductions in arterial diameter. Immunosuppression leaves people with SCI vulnerable to infections and their associated inflammatory cascades. There is substantial reorganisation in the central nervous system in response to injury, at both spinal and cortical levels. Musculoskeletal deterioration, such as fractures and pressure ulcers, as well as infections, then give rise to serious and costly long-term secondary complications. People with SCI are considered to be at the highest risk for an inactive lifestyle, with 40% of the activity levels of able-bodied peers. SCI predisposes to obesity and carbohydrate and lipid abnormalities, largely as a consequence of extreme inactivity.

Physical activity appears to be a critical factor in the maintenance of the health of the person with SCI in general, as well as maintaining major organ systems. The evidence to date shows that regular physical activity is effective in improving fitness, and that muscle and arterial atrophy can be reversed through functional electrical stimulation (FES)-assisted exercise of the paralysed limbs. However there is a need for further research to determine optimum dosage of interventions to achieve specific goals, for example, prevention of muscle atrophy and osteoporosis, and preservation of neural function. Barriers to exercise, such as a lack of access to suitable facilities and equipment, or the burden associated with using modalities such as FES, need to be addressed. For evaluation of exercise interventions, there is a need for development and validation of simple clinical measures to monitor changes over time, and for consensus on a classification system for physical interventions and use of standardised outcome measures. Physical rehabilitation after SCI needs to move beyond the goal of maximising independence to focus on maintenance of optimum health and fitness, as well as maintenance of target system function below the level of injury.

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