

ICF Case Studies

Translating Interventions into Real-life Gains – a Rehab-Cycle Approach

Recovery After Traumatic SCI

Case Study 06



Imprint

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Recovery After Traumatic SCI

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Preface

Functioning is a central dimension in persons experiencing or likely to experience disability. Accordingly, concepts, classifications and measurements of functioning and health are key to clinical practice, research and teaching. Within this context, the approval of the **International Classification of Functioning, Disability and Health (ICF)** by the World Health Assembly in May 2001 is considered a landmark event.

To illustrate the use of the ICF in rehabilitation practice **Swiss Paraplegic Research (SPF)** together with **Swiss Paraplegic Centre (SPZ)**, one of Europe's leading (acute and rehabilitation) centres for paraplegia and spinal cord injury (SCI), performed a series of case studies. Conducting ICF-based case studies was one approach to address SPF's aim to contribute to optimal functioning, social integration, health and quality of life for persons with SCI through clinical and community-oriented research. The ICF-based case studies project began in October 2006.

In this project, persons of different age groups and gender and who are living with SCI of varying etiology and levels of severity, were accompanied during their rehabilitation at SPZ. The rehabilitation process is then described using the Rehab-Cycle® and the corresponding ICF-based documentation tools. Since persons with SCI are faced with a number of physical, psychological and social challenges, the case studies aimed to cover a broad spectrum of these challenges. With this in mind, each case study highlighted a specific theme of SCI rehabilitation.

A booklet is published for each case study conducted. To better understand the case studies described in these booklets, find below some basic information about SCI, the ICF, ICF Core Sets, the Rehab-Cycle® and the ICF-based documentation tools.

Spinal Cord Injury (SCI)

Spinal cord injury (SCI) is an injury of the spinal cord that results in a temporary or permanent change in motor, sensory, or autonomic functions of the injured person's body. The spinal cord is divided into four sections which can be further subdivided into individual segments:

- 8 cervical segments (C1 to C8)
- 12 thoracic segments (T1 to T12)
- 5 lumbar segments (L1 to L5)
- 5 sacral segments (S1 to S5)

The damage of the spinal cord is called lesion. Important functions such as mobility (motor functions) or sensation (sensory functions) fail below the lesion. To help determine future rehabilitation and recovery needs, the extent of a SCI in terms of sensory and motor functions is described using the American Spinal Injury Association (ASIA) impairment scale.

International Classification of Functioning, Disability and Health (ICF)

The ICF is a classification of the **World Health Organization (WHO)** based on the integrative bio-psycho-social model of functioning, disability and health. Functioning and disability reflect the human experience related to the body functions, body structures, and activities and participation. It is viewed in terms of its dynamic interaction with a health condition, personal and environmental factors.

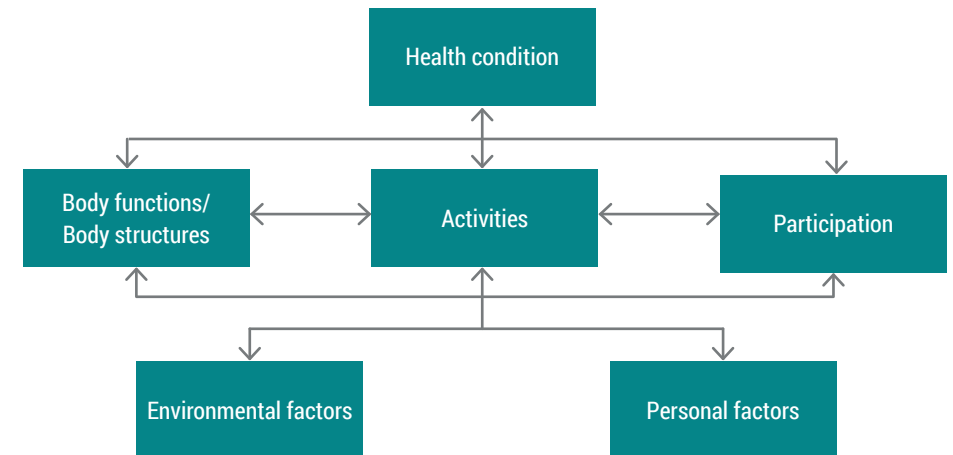


Figure 1: Bio-psycho-social model of functioning, disability and health

The ICF classification corresponds to the components of the model. Within each component, there is an exhaustive list of categories that serve as the units of the classification. ICF categories are denoted by unique alphanumeric codes and are hierarchically organized in chapter, second, third and fourth levels. When going from the chapter level to the fourth level, the category's definition becomes more detailed.

The classification also comprises so-called ICF qualifiers, which quantify the extent of a problem experienced by a person in a specific ICF category. Since environmental factors can also be facilitators, the ICF qualifier for facilitators are indicated with a plus sign.

Generic Scale of ICF Qualifiers	
0	NO problem (none, absent, negligible,...) 0-4%
1	MILD problem (slight, low,...) 5-24%
2	MODERATE problem (medium, fair,...) 25-49%
3	SEVERE problem (high, extreme,...) 50-95%
4	COMPLETE problem (total,...) 96-100%
8	not specified (used when there is insufficient information to quantify the extent of the problem)
9	not applicable (used to indicate when a category does not apply to a particular person)

ICF Core Sets

To facilitate the use of the ICF in clinical practice, it is essential to have ICF-based tools that could be integrated into the existing processes. The first step toward providing ICF-based tools for clinical practice was the development of ICF Core Sets. ICF Core Sets are shortlists of ICF categories that are considered to be most relevant for describing persons with a specific health condition or in a particular setting. In a rehabilitation setting an ICF Core Set can help guide the rehabilitation management process. ICF Core Sets have been developed for several health conditions e.g. for spinal cord injury, health condition groups e.g. for neurological conditions and for various settings. ICF Core Sets can serve as a basis when using the **ICF-based documentation tools** that follow the **Rehab-Cycle®**.

Rehab-Cycle® and corresponding ICF-based documentation tools

The Rehab-Cycle® is one approach that reflects the structured processes inherent in multidisciplinary rehabilitation management. The Rehab-Cycle® consists of an assessment phase, assignment phase, intervention phase and evaluation phase. An ICF-based documentation tool has been developed to guide each of the Rehab-Cycle® phases: the ICF Assessment Sheet, the ICF Categorical Profile, ICF Intervention Table and ICF Evaluation Display. These tools can help a multidisciplinary rehabilitation team to better understand the role of functioning within the rehabilitation process and to more comprehensively describe a person's functioning - hence support ICF-based rehabilitation management.

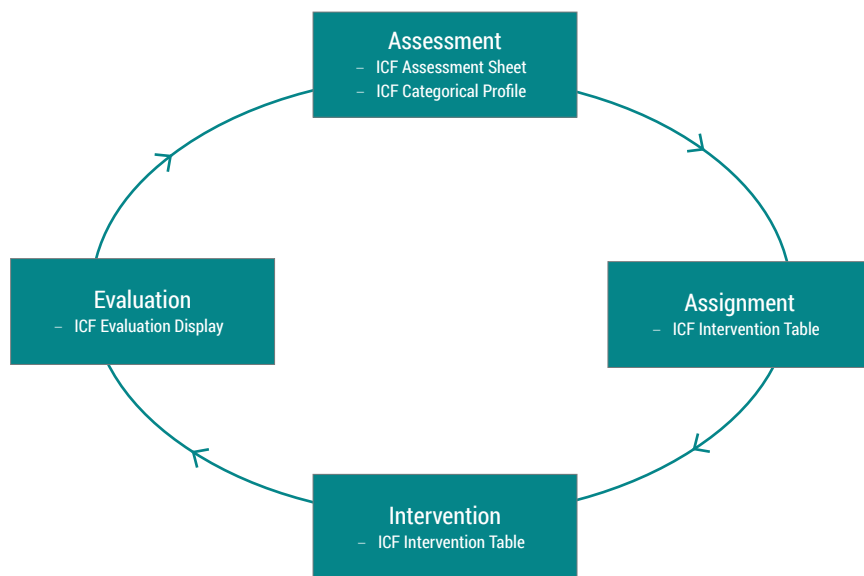


Figure 2: Rehab-Cycle®

You can find more detailed information about SCI, the ICF, ICF Core Sets, the Rehab-Cycle® and the ICF-based documentation tools on the website www.icf-casestudies.org.

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General Introduction



With the sudden and unexpected nature of traumatic spinal cord injury (SCI), concerns and questions surrounding recovery are at the forefront of the minds of the person and all concerned with his or her well-being.¹

Recovery of functioning in traumatic (SCI) depends on two critical factors: the type of injury, meaning both the severity and the etiology,² and on timely and appropriate medical, surgical and

rehabilitative interventions.^{3,4,5,6,7} Such interventions begin at the scene of the accident and continue through to the completion of rehabilitation.

Type of Injury and Recovery

Factors in predicting recovery in the first year after a traumatic SCI include initial neurologic injury level, muscle strength and whether the injury is complete or incomplete.⁸

The level of injury, defined as the first spinal segment that demonstrates an abnormal neurological deficit, describes the region(s) of the body that are affected. Spinal segments are divided into four main groupings: the cervical segments (C1 to C8), thoracic segments (T1 to T12), lumbar segments (L1 to L5) and sacral segments (S1 to

S5). For details go the section "Spinal Cord Injury (SCI)" on page 4. In persons diagnosed with complete SCI at the acute stage, the greatest recovery occurs in those with cervical injuries or injuries from C1 to C8. Thoracolumbar injuries (T10-L2), on the other hand, show the least degree of healing. Irrespective of injury level, recovery of persons diagnosed with incomplete SCI at the acute stage is related to the severity of initial neurological deficits. The fewer the deficits at the acute stage, the higher the rate of recovery.⁹

"The fewer the deficits at the acute stage, the higher the rate of recovery."

In addition, the extent of recovery from an incomplete SCI is greater than from a complete SCI.^{1,8}

A person's recovery can occur early i.e. within hours and days of injury or late i.e. over weeks and months. In 80% of the cases most of a person's overall recovery will take place within the first three months. However, it is also important to note that improvement of neurological func-

tions can take place up to 18 months post-injury and longer. Recovery could be characterized in different ways. For example, it could be characterized as a conversion from having a neurologically complete SCI to an incomplete SCI. In one study, it was observed that 80% of the persons studied showed some conversion in the first three months.¹⁰

"...most of a person's overall recovery will take place within the first three months."

To optimize the prognosis for recovery after SCI, a thorough neurological examination is necessary. This includes the use of magnetic resonance imaging (MRI).¹¹ The ideal time point for an exami-

nation to predict recovery is 72 hours post-injury. Predictions of recovery based on an examination within 24 hours post-injury has shown to be unreliable.^{10,12,13}

Choosing the Right Interventions at the Right Time and Recovery

"I remember lying on the edge of that mountain slope. I couldn't move my head, my hands, nor my legs anymore – nothing..."

Mr. Seiler recalling the accident

Besides the injury type, recovery from an acute SCI can be influenced by the timely provision of appropriate interventions.^{3,4,5,6,7} For example, arterial spasms or pressure on veins caused by oedema following an acute SCI can lead to ischaemia due to an interruption of the spinal cord blood supply. Ischaemia can, in turn, lead to paraplegia. Immediate or rapid restoration of the blood supply to the spinal cord can possibly reverse or reduce the severity of ischaemia-caused paraplegia after

traumatic SCI.¹⁴ This is one example that illustrates the need to provide interventions as soon as possible after injury to prevent permanent damage or loss of functioning. In fact, 25 % of SCI damage can occur or is aggravated after the initial event.^{3,15} Post-SCI damage can occur during the transport of the person from injury site to the hospital, or even in the early period of treatment and evaluation. Given this, it cannot be emphasized enough that for persons with traumatic SCI, rehabilitation begins at the scene of the accident. This means that it is essential that laypersons at the scene of the accident take proper steps e.g. minimize moving the injured person to prevent further damage.

"...rehabilitation begins at the scene of the accident."

Emergency first responders also need to exercise pre-hospital management procedures appropriate for suspected SCI, undertaking **proper immobilization and transport procedures** when indicated. Persons suspected of having an SCI need to be

transported securely and rapidly (in some cases by helicopter) ideally to a regional spinal cord trauma centre or otherwise to the nearest emergency care department.^{3,6,16,17,18}

Pre-hospital Management and Traumatic SCI

The primary goal of pre-hospital management of persons who have experienced trauma is to **deliver care and appropriate interventions as soon as possible** in order to maximize the person's chance of survival as well as improve

outcomes. For persons after a traumatic SCI, pre-hospital management is important for both reducing existing neurological deficits and preventing further damage.^{3,19}

Box 1 Optimal Pre-hospital Management

In the event that a traumatic SCI is suspected, it is essential that critical steps are taken by emergency first responders to prevent further injury. Some guidelines include but not limited to the following:

For lay first responders:²⁰

1. **Call the local emergency medical helpline.**
2. The **person suspected of a SCI should be kept still**, if possible by placing heavy towels on both sides of the neck or by holding the neck to prevent movement.
3. **Appropriate first aid** should be provided as much as possible, whereby avoiding tilting back the head if opening the person's airway is not required. If the person is not breathing, actions to prevent potential SCI is less of a priority. The **first priority is to get the person breathing** again as soon as possible by implementing appropriate first aid procedures.
4. If a person is wearing a helmet, it should not be removed.
5. If necessary to avoid danger or further injury, moving the person suspected of SCI should be done with at least two people to help keep the person's head, neck and back aligned.

For medically-trained first responders:^{3,6,15,21}

1. A **primary evaluation of the person's vital functions** such as breathing should be done, and appropriate first aid (the "ABCs" or airway, breathing and circulation) should be performed to control and **restore vital functions**.
2. A **secondary more thorough examination** should be performed and documented. This includes considering the complaints or indication of symptoms communicated by the

injured person e.g. pain in the neck or back, observe if there is sensitivity to palpation, muscle weakness, paralysis or altered sensations, incontinence, priapism, increased skin warmth or flushing, and other superficial signs of injury.

3. In addition, to determine a potential cervical SCI the presence of the following should be evaluated: altered mental state, intoxication, extremity fracture or distracting injury, localized neurological deficit or spinal pain and tenderness.
4. The entire spine of the person suspected of a SCI should be immobilized in a neutral position at the scene of injury as well as during the transport to the nearest emergency care department or spinal cord trauma centre.
5. Any movement of the person suspected of a SCI, whether for removal from injury site or during transport, must be undertaken with extreme care and in a systematic way. **Immobilization** can be facilitated by using a range of devices including cervical collars, rigid spinal boards with straps, vacuum splints and sandbags. A combination of a cervical collar with supportive blocks on a rigid spinal board with straps is recommended for immobilizing the person during transport. Immobilization devices should be removed should a SCI is ruled out or as soon as definitive treatment is initiated.
6. **Respiratory management** is vital. SCI of the upper cervical region can be accompanied by acute respiratory failure and hypoxia. Interventions such detection and monitoring of hypoxia using pulse oximetry (technology for monitoring oxygen level in the blood), administering oxygen via a face mask, intubation and/or controlled ventilation may be warranted. Should intubation of the trachea to open up the person's airway is required, immobilization devices should be opened while manually maintaining the cervical spine in a neutral position, if possible by two people.
7. Persons who experience SCI are also at **risk for cardiovascular problems** such as neurogenic shock. Appearance of these problems can be countered by carefully laying the person on the back with the feet higher than the head and by administering intravenous fluids (called fluid resuscitation).
8. Hypotension should be prevented and treated if already present. The first-line treatment is fluid resuscitation; this should not include infusion of glucose due to the risk of oedema and hyperglycaemia. Ideally the glucose level is measured and appropriate treatment is provided only once admitted to the hospital.
9. Due to potential for impaired **thermoregulation** after a SCI, it would be essential to monitor and regulate the injured person's temperature.
10. The choice of the mode of transportation and decision about the **type of trauma centre** depends on the status of the person suspected of having a SCI. Stable injured persons are preferably transported to the nearest level 1 trauma centre even if the transport time is longer. Level 1 trauma centres offer the highest level of care, has a full range of equipment as well as specialists available 24 hours a day, and admits a minimum required annual volume of severely injured patients. Unstable injured persons should be transported to the nearest trauma centre irrespective of level; the goal here is to achieve **haemodynamic stabilization** of the injured person before transferring to a level 1 centre.

Acute Care Management at the Trauma Centre

The care that begins upon admission to the hospital or trauma centre builds upon the efforts of the emergency first responders. Ideally, persons with SCI are admitted to a trauma centre that specializes in spinal injuries. Studies have demonstrated that those admitted to specialized centres have a lower rate of subsequent complications, reduction of required acute care and shorter length of stay.^{3,8,22}

Acute care management aims to minimize the damage of the SCI, manage any acute consequences of the SCI and apply interventions that will avert expected complications, for example through conservative pharmacological treatment or more aggressively through a surgical intervention.⁶

From Acute Care to Rehabilitation

In addition to treatment decisions, the appropriate time point for admission to early post-acute rehabilitation must be decided. Studies have shown that rehabilitation that starts early on can lead to better functioning outcomes and an improved rate of recovery, even in cases in which the medical status of the injured person has not yet been completely stabilized.^{4,26}

Following admission to the hospital or trauma centre, the determination of location, extent and severity of the SCI and the adequacy of the blood supply to the spinal cord can be made using various assessment and diagnostic tools. This includes but not limited to the American Spinal Injury Association (ASIA) impairment scale and imaging technology (e.g. MRI). With the data generated using these tools, a more accurate diagnosis as well as a prognosis for recovery can be made.^{11,14} An accurate diagnosis and prognosis are critical for making decisions on the appropriate interventions,^{6,12} such as pharmacological treatment, surgery or other less invasive interventions.^{5,23,24,25}

This case study of Mr. Seiler, a 65-year old retired butcher with incomplete tetraplegia, illustrates how proper and timely acute care, beginning at the injury site, and early rehabilitation can contribute to improved recovery and optimal functioning.

Mr. Seiler's Story



"As I was tumbling down the mountainside, I thought to myself, 'My God, when am I going to stop!' I was totally conscious the whole time I was falling. When I came to a halt, I was freezing and shaking, and I couldn't move my arms and legs. I was so very afraid. Like the old cliché goes – I saw my life flash before my eyes. I continue to relive this experience over and over again!"

Mr. Seiler

Mr. Seiler, a 65 year-old divorced man with three grown children, continued to be very active even after his retirement. Even after retiring from his long career as a butcher, Mr. Seiler regularly assisted local farmers with various jobs including working the fields. He was also a very active sportsman – skiing, hiking, jogging, and a passionate rock 'n' roll dancer. All of this came to a halt when he experienced a farming accident.

The Fall

One morning while assisting a local farmer with feeding sheep on a steep mountainside, one of the more spirited sheep rammed Mr. Seiler, immediately knocking him over and sending him down the mountain slope. He fell rapidly, plummeting about ten metres before coming to a stop before

more damage was done. However, he was unable to move neither his arms nor legs, and he lay helpless and in shock for some minutes before his fellow farm workers realized what had occurred and ran to his rescue.

First Aid at the Scene

When the other farm workers arrived at the scene, they assessed the situation, and made a critical decision i.e. not to move him and immediately call the rescue service. This was the starting point of Mr. Seiler's rehabilitation journey.

While one of the other farm workers carefully descended the slope to stay with and comfort Mr. Seiler, an **emergency crew from a regional spinal cord injury (SCI) centre** had been dispatched and was on the way to the injury site in a helicopter,

the ideal mode of transport for persons suspected of a SCI. The emergency crew arrived within 15 minutes.

After a **rapid assessment of the situation** and a brief discussion with the farm workers, the emergency crew suspected that Mr. Seiler suffered a hyperflexion trauma. They stabilized Mr. Seiler's cerebral column

Optimal Acute Care

Mr. Seiler was **admitted to the intensive care unit of the SCI centre**, where he immediately received acute care and was evaluated thoroughly by the health care team.

"When I arrived in the emergency room I thought 'This is the end of my life'. I told the doctors that I just wanted to die. I wanted them to kill me – my body wasn't working anymore...One of the doctors told me that they don't kill anyone ... and are only there to help me. Somehow, I believed him and it calmed me down. They were all so kind, and that really pulled me through. I felt that they were all doing their best."

Mr. Seiler upon arrival in the emergency room of the SCI centre

Mr. Seiler was found to be oriented (with the highest Glasgow Coma Scale²⁷ score of 15 meaning no problem) and in stable condition. With regards to his neurological status, Mr. Seiler presented with clinical signs and symptoms of an **ASIA C sub-C4 tetraplegia**, indicating an **incomplete SCI with a lesion at the chest/shoulder level with some motor functioning but with sensory functioning problems below the lesion**. There was also suspicion of medial medullary syndrome. Following the assessment, he was medically treated with analgesics for pain, prophylactic treatment for ulcers, thrombosis and for bowel management, as well as intensive respiration therapy for breathing functions.

with a stiff neck brace and the spinal column on a vacuum mattress. Mr. Seiler was carefully evacuated to the SCI centre. During the whole time from the rapid assessment to the transport to the SCI centre, Mr. Seiler's consciousness and cardiopulmonary state were carefully monitored and appropriate pharmacological interventions were undertaken to treat his neurogenic shock.

See "Table 1: ASIA Impairment Scale" on page 24 at the end of this booklet.

While spinal stabilization surgery was initially considered, based on the extent and type of injury a decision was made to first treat the injury conservatively with a neck brace for three months. After Mr. Seiler's condition was stabilized, he was admitted to the Intensive Care Unit (ICU).

To his and his health care team's relief, Mr. Seiler's recovery proceeded quickly and without complications. He wanted to avoid surgery if at all possible, and fortunately, his health care team made the decision to treat the impaired structures conservatively.

Marked increases in neurological recovery were already evident within a few days, particularly in his upper extremities where residual nerve stimulation recovered some degree of power and fine hand function. His forearms showed neuropathological symptoms of paresthesia (or a skin sensation, such as burning, prickling, itching, or tingling, with no apparent physical cause) and dysaesthesia (an abnormal unpleasant sensation felt when touched, caused by damage to peripheral nerves), and increasing neuropathic pain. Medical treatment for these symptoms continued in the ICU as well as in the subsequent

rehabilitation unit. In addition, catheterization was regularly performed as part of bladder management, and respiratory therapy was completed successfully.

"Seven days following his accident, Mr. Seiler was discharged to the rehabilitation unit for early post-acute rehabilitation."

Seven days following his accident, Mr. Seiler was discharged to the rehabilitation unit for early post-acute rehabilitation. At the time he was conscious and approachable with normal reactions. All of his vital signs were within normal limits, and his neurological functions were improving steadily. At that point in time, a Rehab-Cycle[®] was initiated to optimize Mr. Seiler's recovery.

"A few days after the accident, I said I wanted to walk. The health team didn't believe that I could, but I insisted on trying at the very least. My physician agreed, and with the nurses' help I managed to walk a bit. This was so encouraging – I can't begin to describe it! An incredible psychological booster!"

Mr. Seiler

Assessment

Treatment at the rehabilitation unit began with the rehabilitation team's assessment of Mr. Seiler's functioning. The 4-week assessment encompassed a battery of discipline-specific evaluations (health professional perspective) and also involved gathering information from Mr. Seiler himself (patient perspective).

Kicking-off the Rehab-Cycle®

Throughout the Rehab-Cycle® the ICF components of body functions, body structures, activities and participation, environmental and personal factors are kept in mind in all rehabilitation activities. Especially in the assessment phase of the Rehab-Cycle®, assessment results as documented on the **ICF Assessment Sheet** are structured according to these ICF components, and differentiated between the 'health professional perspective' and 'patient perspective'.

See "Table 2: ICF Assessment Sheet" on page 27 at the end of this booklet.

With regards to Mr. Seiler's perspective, he saw as important elements of his functioning the aspects of body functions that focused on hand pain and aspects of activities and participation that centred on mobility and independence. The com-

bination of reduced muscle power and strong pain in his hands limited Mr. Seiler's ability to perform various tasks that required the use of his hands such as handling objects and self-care activities like washing and dressing himself. In fact, he was dependent on the nurses to assist him with self-care.

Moreover, due to the reduced muscle power in the lower extremity, or in Mr. Seiler's own words "my legs are weak", he was not able to climb stairs. He also associated walking on flat surfaces with a feeling of weakness and insecurity. Mr. Seiler's subjective experience of walking was confirmed by the rehabilitation team's assessment results – his impaired gait patterns and the lack of coordination functions increased his risk for falls. Consequently Mr. Seiler was not allowed to walk by himself, at least at this point in time.

"The information and data obtained during the assessment phase would inform goal-setting, the determination of interventions targets, and intervention planning."

In addition to assessment findings in body functions, and activities and participation, the ICF Assessment Sheet showed other relevant factors, such as Mr. Seiler's strong will and disciplined personality, that had an impact on the course of

the subsequent Rehab-Cycle® phases. The information and data obtained during the assessment phase would inform goal-setting, the determination of interventions targets, and intervention planning.

Goal-setting/Determination of Intervention Targets

With use of the ICF Categorical Profile Mr. Seiler's functioning status was discussed during a rehabilitation team meeting. An illustration of the assessment results, the **ICF Categorical Profile** shows the ICF qualifier rating of the categories that reflect the relevant aspects of functioning observed and evaluated during the assessment phase. Goals were set accordingly.

Utilizing a bar-chart, the ICF Categorical Profile provides a visualization of the extent of Mr. Seiler's problems (or lack thereof) in respective ICF

categories. See "Table 3: ICF Categorical Profile" on page 28 at the end of this booklet.

Goal-setting

Based on this initial assessment of Mr. Seiler's functioning, a set of goals were defined by the rehabilitation team, taking into account both their own and Mr. Seiler's perspectives. A global goal, a service-program goal and three cycle goals were established. Considering Mr. Seiler's various hobbies and his desire to work again, 'reintegration in the community through participation' was set as the **global goal**. Since independence from nursing assistance was extremely important for Mr. Seiler, the **service-program goal**

was defined as 'independence in daily activities'. All of the goals were interconnected. Achieving this service-program goal would bring Mr. Seiler closer to reaching his global goal. Likewise, success in the three cycle goals set would help Mr. Seiler achieve his service-program goal. The three **cycle goals** were:

1. manipulating objects with the hands
2. independence in moving around in different locations
3. independence in self-care

Determination of Intervention Targets

Part of goal-setting included defining the goal value i.e. rating as represented by an ICF qualifier that the rehabilitation team expected to achieve after the completion of intervention. The rehabilitation team hoped that, given Mr. Seiler's type of injury and his personal factors of athleticism, discipline and strong will, the goals set would all be reached.

Pain in upper limb, d7304 Power of muscles of all limbs, d440 Fine hand use, and d445 Hand and arm use were identified as intervention targets since they were associated with cycle goals 1 (manipulating objects with the hands) and 3 (independence in self-care). These intervention targets were meant to address the hand pain Mr. Seiler experienced and the limited functionality of his hands.

If a goal with a goal value was defined for a specific ICF category, this ICF category was considered an **intervention target** and would be addressed by a corresponding intervention. For example, b28014

The intervention targets served as essential elements in the next phases of the Rehab-Cycle® – Assignment and Intervention.

Assignment and Intervention

Each of the intervention targets that were defined in the assessment phase of the Rehab-Cycle® was assigned to the appropriate rehabilitation team members – physician, nurse, physical and occupational therapist.

The **ICF Intervention Table** shows the intervention targets that Mr. Seiler's rehabilitation team planned to address with specific interventions, the interventions themselves and the team members assigned to perform the interventions.

See "Table 4: ICF Intervention Table" on page 30 at the end of this booklet.

An example of an intervention target was d450 Walking; it was designated to meet cycle goal 2, 'independence in moving around in different locations'. While the rehabilitation team was initially hesitant to allow Mr. Seiler to walk by himself, they later agreed given his rapid recovery and enthusiasm. The interventions to address this target was carried out by the nurse and physical therapist who accompanied Mr. Seiler during brief walking attempts.

Another example of Mr. Seiler's intervention targets was 'looking after one's health'. This target, that was assigned to all rehabilitation team members, was integral to achieving the service-program goal 'independence in daily activities', as well as Mr. Seiler's overall recovery. The interventions that were planned to address this intervention target focused on appropriate health behav-

ior. This included counseling and education to prevent future complications, such as pressure sores, and further injury to his cervical spine. He was taught exercises that he was able to do on his own.

Reflective of Mr. Seiler's positive personal factors i.e. strong will and self-discipline, he was not only compliant with the interventions, he took on an active role and independently performed additional training.

"Mr. Seiler is an extraordinary patient. He has lived a very disciplined life and has an extraordinary awareness of his body. He's extremely dynamic, always in motion with both body and mind. Considering all of this, he is also very realistic and has strong decision-making skills. Attributes like these really supported him during rehabilitation. He has made enormous progress in his recovery process over a very short period of time."

Mr. Seiler's physical therapist at the end of the Rehab-Cycle®

The interventions were carried out over a period of four weeks. After the four weeks, a final evaluation was performed to determine how well the goals were met.

Evaluation



Four weeks after Mr. Seiler's traumatic accident, the early post-acute Rehab-Cycle® was concluded with an evaluation of progress. The encouraging results showed that Mr. Seiler's recovery had surpassed his own expectations as well as those of the rehabilitation team.

The positive course of recovery of Mr. Seiler's impaired body structures, as well his pro-activity, motivation and self-discipline all contributed significantly to his rehabilitation success.

Not only were all of the intervention target goals achieved, six of the intervention targets remarkably exceeded the expected outcome – for example the intervention targets that were addressed to relieve Mr. Seiler of hand pain and increase the functionality of Mr. Seiler's hands. The intervention target b28014 Pain in upper limb was expected to reach a final value of '1' after being addressed with medication. Since Mr. Seiler experienced no more pain in the upper limbs at the time of the evaluation, this intervention target was rated with a final value of '0', thus exceeding the expected outcome. Likewise, d440 Fine hand use, rated as severe at the assessment phase and addressed with exercises that required him

to grab different types of material and functional games, was rated as a minor problem at the evaluation phase. A similar picture was also seen in the improvement of d445 Hand and arm use. As a result of this "over-achievement" in these intervention targets, Mr. Seiler exceeded the expected final value for cycle goal 1 i.e. manipulating objects with the hands.

See "Table 5: ICF Evaluation Display" on page 32 at the end of this booklet.

Consequently, overwhelming success in all of the cycle goals contributed to reaching the anticipated service-program goal of greater independence in daily activities.

"The whole process of Mr. Seiler's recovery has proceeded exceptionally, starting from the actions of those who first found him

to the actions of the rescue crew and the medical team responsible for his acute care and rehabilitation ... and of course, Mr. Seiler himself. Each person involved was a link in a chain of events that directed an accident victim toward the best recovery possible. We are all pleased beyond words."

Mr. Seiler's physician

"I think I'm one of the happiest patients here. Within one month, I've recovered so much. I didn't think I would have my health back again. It's my second life – I never thought I'd stand again. I will absolutely not take this second life for granted!"

I think being athletic helped me a lot – my swimming, skiing and working hard all contributed. I have a lot of strength and stamina. I drink very little and don't smoke. Overall, I'm an exceptionally healthy person. Even my medical examinations after the accident showed I was in great health – this was really encouraging...I have to admit that the greatest support for me was the care I received. The rescue workers, the intensive care team and the rehabilitation team were all so warm and understanding; they really helped me along psychologically."

Mr. Seiler reflecting on his recovery process at the end of the Rehab-Cycle®

Discussion

The case study of Mr. Seiler, who became tetraplegic after falling down a side of a mountain, exemplified that optimal recovery of persons with traumatic spinal cord injury (SCI) does not begin at the early post-acute rehabilitation phase but already at the time of the accident and extends through to acute care and beyond. Moreover, optimal recovery depends on the contributions of health professionals and the injured person alike.

Actions of the of the rescue team, members of the acute medical team and rehabilitation team as well as the involvement of the injured person him or herself have a major impact on the overall functioning outcome.

"The rescue team's utilization of appropriate spine stabilization devices and careful extraction also prevented damage."

While the degree of an injury person's functional recovery is first and foremost related to the **type and severity of injury**,^{1,2,8} **decisions made early** on can have a significant effect on the person's recovery. **Timely and appropriate interventions** support optimal outcomes,^{3,4,5,6,7} while early missteps can be detrimental to the injured person, potentially causing further harm to the spinal cord.

"...decisions made early on can have a significant effect on the person's recovery."

In Mr. Seiler's case the decision of his colleagues, who found him on the mountainside, to not move him and immediately call the rescue service set the stage for a positive and speedy recovery. This critical decision helped to minimize further potential damage. Subsequently, the rescue team's utilization of appropriate spine stabilization devices and careful extraction also prevented damage. Their decision to evacuate Mr. Seiler by helicopter offered the benefits of rapid transport (allowing acute care to begin sooner) and minimized unnecessary movement that would have occurred with ground transportation. In addition, the fact that Mr. Seiler's SCI was incomplete increased his chance for full recovery. However even in Mr. Seiler's case, the type of injury and rapid access to appropriate care were not the only factors that contributed to his successful rehabilitation outcomes.

The results at the end of Mr. Seiler's Rehab-Cycle® were remarkable. He achieved all of the goals he and his rehabilitation team set, many beyond all expectations. While it is difficult to prove the extent Mr. Seiler's personal factors promoted

his recovery, these factors were without a doubt very important. His good general health, physical strength, willpower, self-discipline and motivation benefited his rehabilitation.

“His good general health, physical strength, willpower, self-discipline and motivation benefited his rehabilitation.”

While Mr. Seiler’s case provides a clear example of successful recovery of a person with traumatic SCI, it is not representative of many others with SCI. However, there is reason for optimism. For all persons living with SCI, advances in pharmacological and other interventions, such as functional neuromuscular stimulation (use of electrical stimulation to activate paralyzed muscles) and effective physical body training, all strategies that promote the natural recovery of the body, enhances the prospects for better rehabilitation outcomes and ultimately improved recovery.^{12,14}

Annex

- Table 1: ASIA Impairment Scale
- Table 2: ICF Assessment Sheet
- Table 3: ICF Categorical Profile
- Table 4: ICF Intervention Table
- Table 5: ICF Evaluation Display
- Literature
- Questions

Table 1: ASIA Impairment Scale

ASIA Impairment Scale											
Motor function		Light touch				Pin prick					
R	L	R	L	R	L	R	L	R	L		
C2				C2	2						
C3				C3	2						
C4				C4	2						
C5	4	5	Elbow flexors	C5	1						
C6	2	3	Wrist extensors	C6	1						
C7	5	5	Elbow extensors	C7	1						
C8	1	2	Finger flexors	C8	1						
T1	0	0	Finger abductors	T1	2						
T2				T2	2						
T3				T3	2						
T4				T4	2						
T5				T5	2						
T6				T6	2						
T7				T7	2						
T8				T8	2						
T9				T9	2						
T10				T10	2						
T11				T11	2						
T12				T12	2						
L1				L1	2						
L2	4	4	Hip flexors	L2	2						
L3	4	4	Knee extensors	L3	2						
L4	4	4	Ankle dorsiflexors	L4	2						
L5	4	4	Long toe extensors	L5	2						
S1	4	4	Ankle plantar flexors	S1	2						
S2				S2	2						
S3				S3	2						
S4-5				S4-5	2						
Sum	32	+ 35		Sum	52	+	52		+		
		= 67					= 104		=		

ASIA Impairment Scale

- A Complete: No motor or sensory functions as preserved in the sacral S4-S5
- B Incomplete: Sensory but no motor function is preserved below the neurological level and includes the sacral S4-S5
- C Incomplete: Motor function is preserved below the neurological level, and more than half of key muscles below the neurological level have a muscle grade less than 3
- D Incomplete: Motor function is preserved below the neurological level, and at least half of key muscles below the neurological level have a muscle grade of 3 or more
- E Normal: Motor and sensory functions are normal

Table 1: Mr. Seiler's ASIA impairment scale score as measured by the health care team at his admission to the SCI centre. This score comprehensively evaluates sensory and motor functions. Sensory functions are graded with 0 = absent, 1 = impaired or 2 = normal. Motor functions are graded from 0 = total paralysis to 5 = active movement with full range of motion, against gravity and provides a level of resistance. In Mr. Seiler's case, the impairment was below the level of cervical segment 4 (C4) i.e. at the level of the upper chest and shoulder, and given the varying degree of sensory and motor functions, was classified as an incomplete tetraplegia.

Table 2: ICF Assessment Sheet

ICF Assessment Sheet			
Patient Perspective	Body Functions & Structures	<ul style="list-style-type: none"> - I have severe pain in my hands - I have only a little power in my hands - Somehow I can move my legs - I have less sensations in my arms and legs - My legs are weak 	<ul style="list-style-type: none"> - I am not allowed to walk by myself - I feel a little bit weak while walking - I can't climb stairs - I can transfer myself on my own - I can wash myself, but feel a bit weak - I need help in dressing myself - I have problems handling objects with my hands - I do the housework - I work on a farm - I dance rock 'n' roll - I have been doing sports my whole life - I love to go skiing, biking, jogging and hiking
		<ul style="list-style-type: none"> - Touch functions in all limbs – reduced - Bladder functions – not impaired - Bowel functions – not impaired - Respiratory functions – at risk - Mobility of joints – not impaired - Muscle power functions – reduced - Involuntary movement reaction functions – reduced - Control of voluntary movements – reduced - Coordination of voluntary movements – reduced - Gait pattern functions – reduced 	<ul style="list-style-type: none"> - Changing body positions – not limited - Transferring oneself – not limited - Fine hand functions – limited - Hand and arm functions - Walking by himself – not allowed - Washing himself – somewhat limited - Dressing (tying shoes) – partially limited - Looking after one's health – above average
Health Professional Perspective			
		<p>Environmental Factors</p> <ul style="list-style-type: none"> - Living in a three-and-a-half room flat - Health professionals are extremely supportive - Medication - Adapted cutlery 	<p>Personal Factors</p> <ul style="list-style-type: none"> - 65 years old - Divorced - Has girlfriend - Retired butcher, but still working on a farm - Has three children - Living by himself - Sporty person - Often "too active" - Extremely disciplined - Has a strong will

Table 3: ICF Categorical Profile

ICF Categorical Profile											
Assessment											
ICF categories	ICF Qualifier					Goal Relation	Goal value				
	0	1	2	3	4						
Global Goal: Reintegration in the community through participation							0				
Service-Program-Goal: Independence in daily activities							0				
Cycle goal 1: Manipulating objects with the hands							1				
Cycle goal 2: Independence in moving around in different locations							1				
Cycle goal 3: Independence in self-care							0				
ICF categories	ICF Qualifier					Goal Relation	Goal value				
	0	1	2	3	4						
b260							-				
b265							1				
b28014							1,3				
b440							SP				
b525							-				
b620							-				
b710							-				
b7304							1,2,3				
b755							2				
b7602							2				
b770							2				
d410							-				
d420							-				
d440							1,3				
d445							1,3				
d450							2				
d510							3				
d520							3				
d530							-				
d540							3				
d550							1				
d570							SP				
d440							2				
d445							1				
d450							1				
d510							0				
d520							0				
d530							-				
d540							0				
d550							0				
d570							0				
	facilitator				barrier						
	4+	3+	2+	1+	0	1	2	3	4		
e1101											
e1151										1	
e155										-	
e310										-	
e355										-	
e450										-	
e580										-	
pf										-	
pf										-	
pf										-	

Table 3: ICF Categorical Profile; ICF Qualifier: rate the extent of problems (0 = no problem to 4 = complete problem) in the components of body functions (b), body structures (s), activities and participation (d) and the extent of positive (+) or negative impact of environmental (e) and personal factors (pf); Goal Relation: 1, 2, 3 refers to Cycle goal 1, 2, 3 and SP refers to Service-Program Goal; Goal value refers to the ICF-qualifier to achieve after an intervention

Table 4: ICF Intervention Table

ICF Intervention Table										
	Intervention target	Intervention	Doc	Nurse	PT	OT	First Value	Goal Value	Final Value	
Body function/structure	b265	Touch functions	Working with different materials			x	2	1	1	
	b28014	Pain in upper limbs	Medication	x			3	1	0	
	b440	Respiration functions - at risk	Inhalation, Instruction for self-training of deep breathing		x		0	0	0	
	b7304	Power of muscles of all limb	Manual muscle power training, Muscle power training with equipment		x	x	2	1	1	
	b755	Involuntary movement reaction functions	Balance and reaction training		x		2	1	0	
	b7602	Coordination of voluntary movements	Training of coordination		x		2	1	0	
	b770	Gait pattern functions	Gait training		x		2	1	0	
	d440	Fine hand functions	Grabbing different materials, Functional games			x	3	2	1	
	d445	Hand and arm use	Functional games			x	2	1	1	
	d450	Walking	Walking with supervision		x		2	1	0	
Activities / Participation	d510	Washing oneself	Assistance and guidance		x		1	0	0	
	d520	Caring for body parts	Assistance		x		1	0	0	
	d540	Dressing	Assistance and guidance		x		1	0	0	
	d550	Eating	Assistance		x		1	0	0	
	d570	Looking after one's health	Instruction for precautions	x	x	x	1	0	0	
	Environmental factors	e1151	Assistive products...for personal use in daily living	Choice and arrangement of assistive devices			x	2 (+)	2 (+)	1 (+)

Table 4: ICF Intervention Table; Doc = Physician; PT = Physical Therapist; OT = Occupational Therapist. The first value refers to the rating at the initial assessment, the goal value refers to the rating that should be achieved after the intervention, and the final value refers to the actual rating at the second assessment or evaluation. ICF qualifiers were used to determine these ratings (0 = no problem to 4 = complete problem) in the intervention targets. For the intervention targets representing the environmental factors, the plus sign next to value indicates a facilitator.

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Questions

- Q1. Name three determinants for neurological recovery in spinal cord injury (SCI). *(Refer to page 8 for the answer.)*
- Q2. How early can the recovery of a person with SCI take place? *(Refer to page 9 for the answer.)*
- Q3. What contributions to neurological recovery can be made by laypersons at the scene of an accident? *(Refer to page 10 for the answer.)*
- Q4. At the scene of Mr. Seiler's accident, what did the first responders (laypersons and health professionals) do that contributed to Mr. Seiler's overall positive outcome? *(Refer to page 13 for the answer.)*
- Q5. In addition to the response at the accident scene, type of injury and provision of rapid and appropriate acute and rehabilitation care, what additional factors contributed to Mr. Seiler's rehabilitation success? *(Refer to page 19 for the answer.)*

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