Swiss Paraplegic Research

Swiss Paraplegic Centre

ICF Case Studies

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

Walking Recovery

Case Study 10

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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.

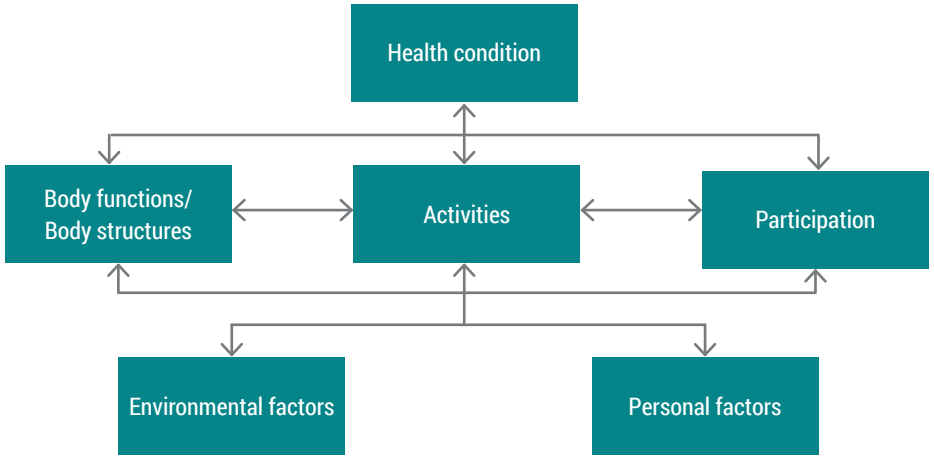

Figure 1: *Bio-psycho-social model of functioning, disability and health*

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 organised 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.

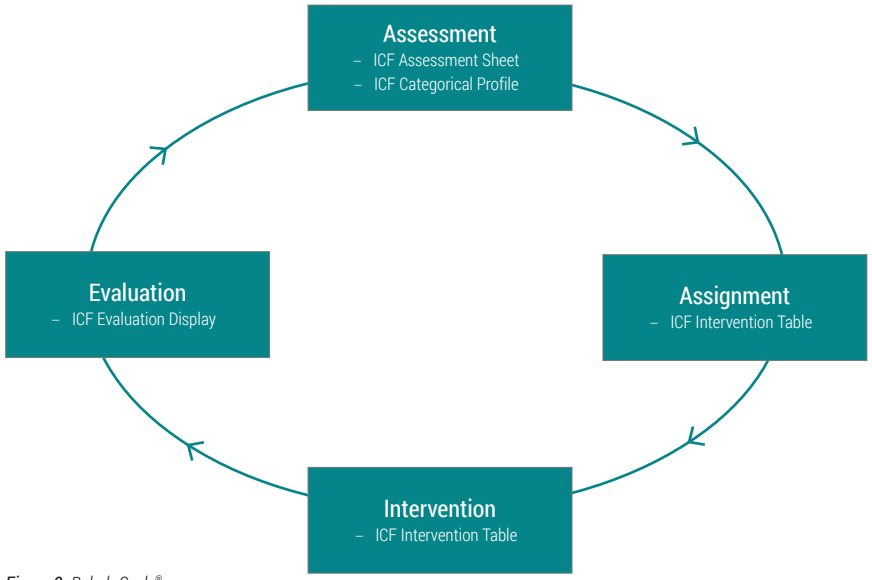

Figure 2: *Rehab-Cycle®*

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

Regaining the ability to walk seems to be a major long-term goal of persons with spinal cord injury (SCI).[1] Considering this and findings that persons with an incomplete SCI are likely to regain some level of walking ability,[2,3,4] exploring ways to facilitate "walking recovery" would be important in rehabilitation management.[1,5]

The Complexity of Walking

Regaining some level of **walking ability in persons with SCI is a complex process that poses a multitude of challenges**. Problems in walking can manifest itself in different ways, including reduced walking speed, longer walking cycles, shorter stride distances and so-called "angular displacements of lower limb joints" i.e. when the position of joints is not in its normal alignment.[5]

The process of **walking itself is also complex, consisting of sub-tasks**, such as but not limited to:[5]

- the production and absorption of energy at key points in the walking cycle
- maintaining a certain trajectory of the foot during swinging of the foot forward
- supporting body weight
- balancing the head, arms and trunk

Case Study 10 | Walking Recovery | General Introduction

Box 1 | The Biomechanics and Physiology of Normal Walking

Physically, a normal walking cycle involves the repetition of two phases: the stance phase and the swing phase. During the stance phase the foot in front contacts or "strikes" the ground; the weight is carried by this single limb. The other foot then moves forward, striking the ground and beginning the swing phase. In the swing phase, the other foot again swings forward returning to the forward position and again striking the ground. This cycle repeats itself again and again.[6]

Walking on two feet is a complex and practiced activity that is considered both automatic and controlled.[7] It **comprises a series of movements** involving multiple body systems and parts.

Advances in gait analysis have increasingly been able to elaborate some of the complicated processes and concepts involved in walking,[8] including

- kinematics i.e. mechanics of motion
- kinetics i.e. the related branch of mechanics that focuses on the interaction between active and passive forces acting on the body
- indirect measurement of muscle force
- temporal-spatial parameters e.g. steps per minute, walking speed, step length, etc.
- and joint angles or the angle between the two body parts linked by a joint e.g. knee angle

A detailed explanation of these concepts is beyond the scope of this case study.

Identifying normal and abnormal patterns of walking using **gait analysis** is the first step toward finding ways to address problems in walking.

With regard to biomechanical and physiological issues that should be addressed in rehabilitation, the following have been identified as essential for the recovery of a person's walking ability:[7]

- the interaction of muscle groups (synergies) required for propulsion
- body balance during the movement
- the adaptation of walking pattern and behaviour according to the person's intention and to the constraints of the environment

Associated with the physiology of walking are the control mechanisms initiated in the brain, such as the mental functions related to the integration of various sensory information e.g. visual, vestibular (related to position, balance and movement involving the inner ear and brain) and proprioceptive (related to sensing the relative position of body parts) functions and the cognition functions that are necessary to refine movements and to drive walking behaviour.[9,10]

Interventions to Improve Walking Ability – A Refined Process

Given the complexity of walking, successful recovery of walking ability in persons with incomplete SCI depends on the consideration of various factors associated with optimal walking, including the biomechanics and physiology of walking, and the selection and integration of appropriate interventions into a comprehensive rehabilitation program.

There are also a number of **factors that seem to impact walking behaviour**, including spasticity, muscle weakness, lack of motor coordination, and postural problems related to bearing weight, balance and propulsion.[5] Thus rehabilitative interventions that are implemented toward regaining walking ability must consider these factors.

Since the recovery of walking in persons with incomplete SCI is complicated by a **significant increase in the risk of falls and subsequent fractures and other injuries**, interventions aiming to optimise walking ability should also incorporate strategies to reduce the risk of falls. This may include evaluating the person's history of falls and conducting tests that identify the factors associated with falls for the particular person.[11]

Evidence from clinical research often impacts the types of interventions undertaken. For example, in one study that compared the walking development of babies with that of persons with incomplete SCI, it has been suggested that strengthening the descending input (or the information the brain emits to body parts) could complement traditional approaches toward recovering walking ability.[10]

There are also some promising findings related to the neurological control of locomotion (or walking). Although inconclusive, it has also been suggested that stimulating the motor centres of the brain and brain stem would activate the so-called "central pattern generator" of the spinal cord that promotes the rhythmic interaction of muscles and movement of limbs involved in walking.[9,10] Moreover, locomotor training that combines **Body Weight-Supported Treadmill Training (BWSTT)** – *See "Box 3 | Locomotor Training – Body Weight-Supported Treadmill Training (BWSTT)" on page 14* – with manual assistance and delivery of sensory cues that target specific locomotor actions seem to have a positive impact on locomotor activity.[9,10,12] This locomotor training approach also adheres to the following principles:[12]

- generating a stepping speed that is similar to normal walking speed
- sustaining normal load on the limbs
- maintaining an upright torso and head position
- producing the mechanical motions of the hip, knee and ankle that resemble normal movement patterns
- synchronising the extension of the hip to promote the alternating loading and unloading of weight on the limbs
- avoiding weight-bearing on the arms
- promoting arm swinging

In essence, recovery of walking ability of a person with SCI compels the person to learn new strategies of movement that resemble normal locomotor movements as much as possible in order to replace lost functions.[13]

Despite the potential role of the aforementioned interventions in recovering the walking ability of persons with SCI, there is still inconclusive evidence which approach is most effective.[14,15,16]

Nevertheless, selecting the appropriate interventions is critical to facilitating the recovery of walking ability and rehabilitation management in general.

Rehabilitation Management – An Exact Science?

Managing the rehabilitation of individual patients is not an exact science. Rehabilitation team members are required to **integrate existing information about the person, the team's clinical expertise, and scientific evidence** to define rehabilitation goals, identify intervention targets, and decide on the appropriate interventions corresponding to these targets, and to attain the goals set.

With regard to recovery of walking ability, it is essential that the rehabilitation team directly responsible for supporting the recovery process possesses knowledge about the physiology and specific pathological mechanisms of walking in persons with SCI. *See "Box 1 | The Biomechanics and Physiology of Normal Walking" on page 9.* This knowledge is part of the clinical expertise the rehabilitation team can employ in the rehabilitation management of persons with SCI i.e. in clinical reasoning and evidence-based rehabilitation. *See "Box 2 | Clinical Reasoning and Evidence-based Rehabilitation" on page 12.*

Although not an exact science, we see that there are various strategies and approaches that can facilitate the rehabilitation management of persons with SCI. In addition to the previously described approaches the Rehab-Cycle® is an approach that can structure the processes that drive multidisciplinary rehabilitation management. Corresponding ICF-based documentation tools can also be used to organise and guide the phases of the Rehab-Cycle®.

This case study of Simon, a 22 year old man with traumatic incomplete SCI, offers an example of how the Rehab-Cycle® and the corresponding ICF-based documentation tools can used in rehabilitation efforts to recover walking ability. It illustrates the importance of identifying intervention targets and appropriate interventions based on concrete goals for successful rehabilitation. It also highlights the utility of clinical reasoning and an evidence-based approach.

Box 2 | Clinical Reasoning and Evidence-based Rehabilitation

Simply defined, clinical reasoning is the **"thinking and decision-making processes that are used in clinical practice"**.[17] Ideally, clinical reasoning also takes into account the perspective of the patient and those of the patient's family and non-clinical care providers. Current models of clinical reasoning emphasize the importance of interacting with the patient and understanding the patient's beliefs, goals and lived experience. Information on and from the patient enriches the treasure-trove of data that the clinician has available to make informed decisions about the rehabilitation of the particular patient.[17,18]

In planning rehabilitation goals, targets and interventions, the clinician must utilise and integrate a variety of information, skills and strategies. Biopsychosocial information is combined with diagnostic, narrative, collaborative and prognostic skills, along with an ability to communicate and recognise clinical cues, patterns and relationships.[19]

Useful for facilitating clinical reasoning, the framework of the International Classification of Functioning, Disability and Health (ICF) and the Rehab-Cycle® can be employed to identify associations of available information as well as promote a flexible, interprofessional and person-focused approach.[17,20]

Another closely related approach to clinical decision-making that can help rehabilitation providers to determine appropriate intervention targets and interventions for a particular person is known as **evidence-based practice**. This approach has been defined as "the conscientious, explicit, and judicious use of current best evidence in making decisions about the care of individual patients... [it integrates] individual clinical expertise with the best available external clinical evidence from systematic research".[21] This also includes considering the individual patient's situation and choice. Thus, the results of up-to-date quality research can help inform decisions made by clinicians, sometimes providing the optimal path to achieving a patient's goals.

However, this evidence-based approach is not always straightforward. For example, Cochrane,[22] an international, independent and not-for-profit organisation that conducts systematic reviews about the effectiveness of healthcare including interventions, reviewed five randomised controlled trials involving 309 persons with traumatic incomplete SCI that examined different locomotor trainings aimed at improving their walking ability. The results of this meta-analysis were inconclusive, illustrating the difficulty of determining which interventions are the best for this specific issue.[15] Thus for the clinician who is assisting a person with incomplete SCI to recover a degree of walking ability, deciding on which intervention to implement will depend on his/her clinical expertise as well as the individual patient's context and choice.

Simon's Story

"I've learned so much over the past six months – my injury has actually turned into a real opportunity for me."

Simon

This statement is a reflection of Simon's personality. An optimistic and motivated 22-year-old, Simon was at the beginning of a promising career as a web graphic designer before his spinal cord injury (SCI). He had a large circle of friends with whom he often went mountain-biking in the countryside and dancing on weekends. In 2007, he went on vacation with a group of close friends to Mallorca, Spain. It was during this vacation that he incurred a fracture of his second cervical vertebrae as a result of a swimming accident. The second cervical vertebrae is the location of critical life functions.

After the evacuation of Simon from the accident site, he was diagnosed with type II dens fracture at the protrusion of the neck where it joins the main body of the vertebrae. Simon was stabilised and treated conservatively until arrangements were made for his safe transport to a SCI centre in his home country of Switzerland. Once in Switzerland, he was admitted to the intensive care unit of the SCI centre, and was initially diagnosed with **complete sub-C2 tetraplegia ASIA A, meaning a severe SCI in which he had a complete lack of motor and sensory functions below his injury**. The medical team opted for surgery to stabilise the fracture. The surgery was performed successfully, and Simon's rehabilitation began.

"...he incurred a fracture of his second cervical vertebrae as a result of a swimming accident. The second cervical vertebrae is the location of critical life functions."

The First Five Months

After the surgery, Simon was moved to the early post-acute unit. During the first two weeks Simon found himself completely dependent on others in all respects. He was on an artificial ventilator 24 hours a day, and received only intravenous nutrition. He was able to move only his eyes and mouth, and wore a stiff Philadelphia (neck) collar in the first six weeks to immobilize his neck and cervical region.

> *"I felt my recovery proceed almost on a daily basis. There were no huge steps, but rather small and continuous improvements."*
>
> *Simon*

After six weeks, his respiratory function had improved significantly, and he required artificial ventilation only at night. Furthermore his stiff neck collar was replaced by a flexible collar that he wore for an additional four weeks. Simon's continuous improvement was captured in his ever-increasing scores on the spinal cord independence measure (SCIM),[23] over the course of the rehabilitation process. *See "Table 1: Spinal Cord Independence Measure (SCIM)" on page 30 at the end of this booklet.*

During the first five-month period, Simon's physical functioning steadily improved, and he achieved a degree of independence in self-care. To support his recovery in walking, the rehabilitation team initiated regular locomotor training three months after his accident. *See box 3.*

Box 3 | Locomotor Training – Body Weight-Supported Treadmill Training (BWSTT)

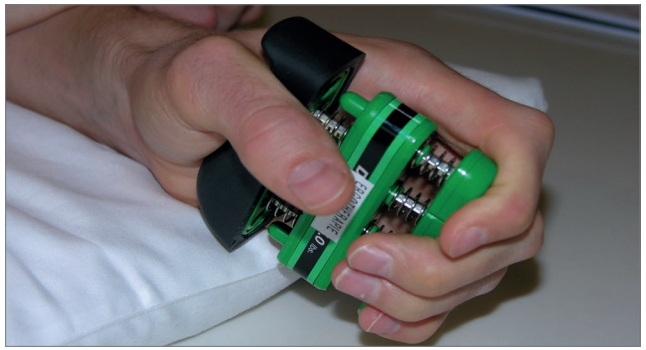
Locomotor training utilises limb movements to produce locomotive sensory information that can promote the recovery of walking ability in persons with SCI. Locomotor training that employs treadmill training is often combined with body weight support; this is called body weight-supported treadmill training or BWSTT. In BWSTT the amount of body weight a person places on certain weight-bearing muscles is controlled by an overhead harness system while the person walks on the treadmill. For example, the body weight support decreases the weight placed on the legs and enables the retraining of various elements of a person's gait. Other interventions include locomotor training combined with electrical stimulation-assisted walking, biofeedback and passive mechanical orthoses.[9,12,14,15]

Although locomotor training has shown to be successful in accelerating recovery of walking ability as well as improving the quality of locomotor pattern in animal studies, results in humans are still inconclusive. However, locomotor training has shown some promise as an intervention in rehabilitation.[12,14,15]

Case Study 10 | Walking Recovery | Simon's Story

Despite improvements in Simon's gait patterns, gait continued to be a limiting factor in walking. However, **after five months of rehabilitation, Simon was able to stand with some support and even take a few steps forward**. In light of Simon's progress in recovering some of his walking ability, he and his rehabilitation team looked forward to the next stage of rehabilitation. With focus on further improving Simon's ability to walk the next stage of rehabilitation employed the Rehab-Cycle® approach.

Assessment



Five months into Simon's rehabilitation, a Rehab-Cycle® began that focused on furthering the recovery of his walking ability. To start off the Rehab-Cycle® an assessment of Simon's functioning was conducted as the basis for defining the goals to address in rehabilitation.

> *"I don't actually have any real problems. I'm independent; I can do anything. What we're talking about here are 'luxury problems'."*
>
> *Simon, five months following injury*

Assessment of Simon's "Problems"

To help guide the assessment process, Simon's rehabilitation team used the ICF Core Set for spinal cord injury (SCI), a shortlist of categories selected from the whole International Classification of Functioning, Disability and Health (ICF). The assessment results were documented from Simon's perspective as well as from the perspective of his rehabilitation team. *See "Table 2: ICF Assessment Sheet" on page 32 at the end of this booklet.* Simon's **ICF Assessment Sheet** provides an overview of his functioning state that is structured according to the components of the ICF i.e. body functions and structures, activities and participation, environment and personal factors. It not only summarizes the results conducted by his rehabilitation team, it also lists Simon's statements about his current situation. **The ICF Assessment Sheet shows that Simon's perspective and that of the rehabilitation team were complementary.** The ICF Assessment Sheet helped Simon and his rehabilitation team to define the goals they would address with specific interventions in the Rehab-Cycle®.

Even after five months of rehabilitation, **a number of outstanding issues in body functions and structures (e.g. impaired gait pattern, spasticity in the lower extremity) as well as activities and participation (e.g. walks only very short distances without devices) were identified as still requiring attention.** In addition to problems and needs, Simon and his rehabilitation team highlighted contextual factors (e.g. elbow crutches, has clear goals, very ambitious) that would support rehabilitative efforts.

Gait analysis revealed that Simon walked with a slight limp due to reduced muscle power and stability in the left hip and knee. Additionally, his exercise tolerance was reduced as a consequence of his impaired respiratory functions and lack of physical activity following the accident.

"In addition to problems and needs, Simon and his rehabilitation team highlighted contextual factors...that would support rehabilitative efforts."

As expected, the rehabilitation team's assessment confirmed **limitations in Simon's mobility**, specifically in his ability to walk, climbing stairs and outdoor mobility. At the time Simon still had to use the wheelchair to move distances that took longer than a few minutes. Driving a car was also difficult.

Beside problems related to his lower extremity, Simon also showed reduced fine hand use and limitations in lifting and carrying objects due to his tetraplegia. This in turn led to limitations in performing daily tasks such as dressing. Simon indicated that the additional time required for dressing decreased his spontaneity.

On a positive note, **Simon had already begun working part-time for his former employer at the time of the assessment**, hoping to return at some point to full-time work. He spent the weekends with his family and friends. Upon discharge from the rehabilitation centre, Simon intended to live with his mother, where he would receive some assistance with performing daily activities.

At the rehabilitation centre, Simon was an active table tennis player, and also attended cultural events organised by the centre's Learning-by-Doing Club. The rehabilitation team recognised that at the time of assessment **Simon's participation in recreational activities that he performed before his injury, such as biking, was significantly reduced**.

In spite of the many areas of functioning that had to be addressed during rehabilitation, Simon possessed several personal factors that contributed to his successes in the Rehab-Cycle®. He was not only ambitious, he expressed clear goals, and was accepting of his disability. He also enjoyed physical activity; this was beneficial since many of the interventions required Simon to be physically active.

"He was not only ambitious, he expressed clear goals, and was accepting of his disability."

With regard to environmental factors, Simon had a **supportive network of family and friends**, and he viewed his rehabilitation team as also very supportive. He had **access to equipment and assistive devices** that facilitated his mobility including a wheelchair and crutches. Moreover, an insurance case-worker helped Simon to deal with all financial and insurance-related issues, relieving him of this additional burden.

With the completion of the ICF Assessment Sheet the first step in the assessment phase of the Rehab-Cycle® was also completed. The next step in the assessment phase was to consider this "laundry list" of needs and functional limitations, environmental and personal factors, and set long- and short-term goals as well as define the intervention targets that Simon and his rehabilitation team would address during the intervention phase.

Goal-setting/Determination of Intervention Targets

While the broad goals of community integration and independent living are common long-term goals set by persons with spinal cord injury (SCI), the steps toward reaching these goals can differ greatly from person to person.

Intertwined Goal-setting

Consistent with this goal-setting tendency, Simon and his rehabilitation team defined 'community integration without limits' as the long-term **global goal** that they would like to reach at the end of rehabilitation. In discussions with Simon, he identified concrete goals he would like to reach – to run and mountain-bike again, to be able to drive and swim again – some goals perhaps more achievable than others. Considering Simon's personal goals and his consistent improvements up to the start of the Rehab-Cycle®, a **service-program goal** of resuming leisure activities was established. This service-program goal is the endpoint of this Rehab-Cycle®. Achieving this would be a big step toward reaching his global goal.

Informed by the assessment results and Simon's expressed goals, two so-called **cycle goals** were defined that would help him resume optimal performance in leisure activities. The first cycle goal (cycle goal 1) was to achieve independence in mobility, specifically to improve Simon's locomotion and ability to move around. This corresponded to Simon's desire to be able to run, drive and ride his bike again. The second cycle goal (cycle goal 2) was to gain independence in carrying, handling and moving objects. This not only supported the efforts toward meeting cycle goal 1 e.g. driving and his service-program goal e.g. bike-riding, it served as a "stepping stone" toward Simon's ultimate goal of community integration without limits. As one can see, all of the goals are intertwined.

Simon's goals were documented on the **ICF Categorical Profile**, a visual depiction of a person's functioning status at the time of assessment showing the ICF qualifier values for selected ICF

categories considered relevant to the person's case. *See "Table 3: ICF Categorical Profile" on page 34 at the end of this booklet.* As previously mentioned the ICF Core Sets for SCI was used to help guide the assessment process; this was also used for completing the ICF Categorical Profile. Since the comprehensive version of the ICF Core Sets for SCI has over 160 ICF categories each, the ICF Categorical Profile for Simon only shows the ICF categories for which a goal was identified.

Determination of Intervention Targets

Setting the global, service-program and cycle goals was essential for the subsequent selection of the **intervention targets** i.e. ICF categories outlined in the ICF Categorical Profile that correspond to any of the goals set and are intended to be addressed with specific interventions, that Simon and his rehabilitation team addressed during rehabilitation. In Simon's case, most of the intervention targets were quite clear.

With respect to cycle goal 1 the intervention targets selected focused on increasing Simon's mobility (or locomotion) in general (including his ability to move around using assistive devices), driving a car, and based upon his progress and prognosis, improving his walking ability.

The intervention targets in the component of body functions included increasing muscle power in all limbs, improving balance, eliminating impairment in muscle tone functions (spasticity), optimising gait patterns and coordination of voluntary movements. Improvement in Simon's respiratory and exercise tolerance functions was also vital for increasing Simon's locomotion. In terms of activities and participation, improving Simon's ability to walk long distances and up stairs, along with enabling him to drive with consideration of SCI-related limitations were also identified as intervention targets. Lastly, since the availability and use of assistive devices (crutches and a wheelchair) were seen as facilitative in improving Simon's ability to walk long distances, the ICF category 'assistive products and technology for personal indoor and outdoor mobility and transportation' was also selected as an intervention target. See table 3 for all intervention targets.

In addition to ICF Categorical Profile, all of Simon's intervention targets were also documented on the ICF Intervention Table and monitored in the next phase of the Rehab-Cycle® – the intervention phase.

Assignment and Intervention

For each intervention target, appropriate interventions were identified and assigned to one or more of Simon's rehabilitation team members.

The spectrum of interventions that support the recovery of walking ability is wide,[16] ranging from pharmacological interventions,[24] for example to eliminate spasticity, to interventions that involve physical activity,[5,9,10,12,13,15] for example to improve gait pattern. As mentioned in the section *General Introduction*, there is inconclusive evidence about the optimal intervention for recovering a person's walking ability. A systematic review of randomised control trials examining various types of locomotor training[15] and pharmacological interventions for spasticity[24] have led to inconclusive results. Despite the lack of evidence in support for one specific therapeutic approach, it seems that a combination of various approaches are commonly employed in clinical practice.[5,9,10,12,14,15]

In Simon's case, the rehabilitation team decided to implement a **combination of various interventions to address the intervention targets** identified. The interventions and the corresponding intervention targets, as well as the rehabilitation team members who were responsible for implementing the interventions were documented on the **ICF Intervention Table**. *See "Table 4: ICF Intervention Table" on page 36 at the end of this booklet.*

The decisions of the rehabilitation team on the best course of action took into account Simon's expressed needs, assessed limitations, recovery progress and and his overall context. The interventions selected were also determined based on available evidence and the rehabilitation team's clinical expertise.

Considering that Simon's medical status had improved considerably and that he had achieved a level of independence in self-care, **nursing assistance was predominately required only for managing medications**. Given that the cycle goals set focused on mobility/locomotion and hand and arm use, the majority of

the interventions in this Rehab-Cycle® were assigned to the physical, sports and occupational therapists, with several overlapping responsibilities.

"Given that the cycle goals set focused on mobility/locomotion and hand and arm use, the majority of the interventions in this Rehab-Cycle® were assigned to the physical, sports and occupational therapists, with several overlapping responsibilities..."

To help further improve Simon's walking ability the rehabilitation team implemented various interventions that addressed different aspects of walking ability. For example, medication was administered to help control the spasticity that constrained Simon's locomotion. **To address the biomechanical and physiological aspects of locomotion/ walking the rehabilitation team implemented a combination of various intervention approaches:**

- To improve respiratory functions as well as the control of voluntary movements in the trunk and limbs, Vojta therapy was provided. *See "Box 4 | Vojta Therapy" on page 23.*
- To improve exercise tolerance, arm ergometer training was implemented. Though inconclusive, studies have shown that overall training can increase aerobic capacity.
- To reduce pain and increase mobility in the right shoulder, passive and active shoulder exercises as part of manual therapy were conducted.
- To improve standing and reaction functions, body balance training and table tennis were implemented.
- To improve bending and shifting Simon's centre of gravity, repetitive training of specific activities was employed.
- To improve gait pattern functions, short- and long-distance walking, walking on different terrain and around obstacles, gait training indoors and outdoors including city training was provided.
- To improve the performance in everyday activities requiring locotion, Simon participated in city training that trained him to move around in outdoor and indoor environments other than home and the rehabilitation centre.

While conclusive evidence for the effectiveness of Vojta therapy is lacking,[16,25] Simon's rehabilitation team felt that Vojta therapy would successfully address Simon's problems in respiratory and neuromuscular functions.

"...the rehabilitation team implemented various interventions that addressed different aspects of walking ability..."

Simon's sports therapist also contributed with a number of interventions, including strength and endurance training in the gym, water therapy to train hand and arm use, and table tennis to train Simon's ability to maintain a standing position. In addition, the sports therapist fostered Simon's participation in sports and leisure.

The occupational therapy interventions addressed cycle goal 2 'independence in carrying, moving, and handling objects', including:

- Specific touch stimulations utilising different materials to improve touch functions
- Repetitive training to improve the control of voluntary movements and joint mobility in the upper extremity
- Therapeutic games that centred on improving fine hand functions, lifting and carrying objects
- Assistance and instruction in activities of daily living, such as preparing meals and dressing, to improve hand and arm use

Moreover, the occupational therapist provided Simon with city training aimed at improving his walking ability indoors and outdoors beyond his familiar environment in and around the rehabilitation centre and home.

In addition to the interventions involving physical activity, the occupational therapist assisted Simon with planning for future employment by coordinating with Simon's former employer, organising driving lessons and facilitating his weekend home-stays.

Box 4 | Vojta Therapy

The Vojta Method, also referred to as "reflex locomotion", is a therapeutic method of treating physical and neurological disorders. Developed by neurologist Professor Vaclav Vojta reflex locomotion involves applying pressure to defined reflex points on the body while in a lying position (on the stomach, on the back or on the side) to illicit reflex locomotion (or automatic, spontaneous movement responses). An important role is played by optimal joint angles of the extremities and the resistance the therapist employs against a specific body part while the person performs a sequence of movements. The resistance on the body part increases the tension in the corresponding muscles while strengthening the muscular activity in the abdomen, back, arms, and legs.[16,25,26,27]

Reflex locomotion focuses on the following therapeutic goals:

1. Maintaining body balance and posture when moving
2. Uprighting the body against gravity
3. Goal-directed grasping and stepping movements of the limbs

Vojta therapy was originally applied to children with cerebral palsy and later extended to adolescents and adults as a rehabilitative intervention.[25,26,27]

Benefits of Vojta therapy include but not limited to:[26,27]

- Improved mobility of the spine
- Correction of posture problems
- Increase in goal-directed use of hands and feet
- Improved breathing
- Better blood circulation to the skin
- Activation of bowel and bladder regulating functions
- Improved balance and reactions
- Increased efficiency of movements
- Decreased loss of muscle mass

Evaluation

"I never expected to make so much progress so quickly. Now I can swim and ride a bike, but there are still some challenges. I'm nervous while swimming and can't yet get onto a mountain bike, which I find really disappointing. But I know these will also improve with time and practice."

Simon at the end of the Rehab-Cycle®

Despite the overall improvement in Simon's functioning as well as in most of the intervention targets defined, these gains were not sufficient to meet the cycle goals. Simon fell just short of achieving the goal values set at the start of the Rehab-Cycle®. Nevertheless, his outlook for the future remained positive.

Over the two-month course of this Rehab-Cycle®, there were measurable improvements to his condition. Most importantly, the overall improvement of his condition was reflected in an upgrade of his ASIA score. Simon's ASIA score went from ASIA A at admission (complete lack of motor and sensory functions below his injury) to ASIA D, meaning that his motor functions below the injury level were preserved with active movement and full range of motion against gravity in at least half of the key muscles.

"...the overall improvement of his condition was reflected in an upgrade of his ASIA score."

The positive results of the interventions intended to improve Simon's walking ability was evident in the transformation from total paralysis to **normal active movement, full range of motion and full resistance in a functional muscle position for some muscles, as well as the sychronised gait pattern and control of voluntary movements**. These advances contributed to the overall improvement of his walking ability. Simon could now walk independently for up to 15 minutes.

"Simon could now walk independently for up to 15 minutes."

However, due to Simon's reduced muscle strength and endurance, he experienced limits to his walking ability. For example, he needed to use crutches if he walked longer than 15 minutes. Furthermore, walking on uneven surfaces such as grass or sand continued to present difficulties resulting from an impaired ability to sense and recognise the relative position of his body. He also continued to have problems with exercise tolerance. Moreover, due to spasticity and reduced strength in his left leg Simon continued to have some problems with driving.

Despite continued problems Simon also acknowledged his gains. For example, due to his improvement in balance and reaction functions he felt more secure walking without assistive devices. To accommodate for continued problems in walking, Simon used a wheelchair and crutches for moving around outdoors and for long distances.

Case Study 10 | Walking Recovery | Evaluation

His therapists were also please with his improved independence in walking and moving around even though cycle goal 1 was not met.

"Simon improved his balance and reaction functions significantly over the past two months. His risk of falling has also decreased, especially on even surfaces and over short distances. He still needs to improve walking on uneven ground."

Simon's occupational therapist at the end of the Rehab-Cycle®

The problems that Simon continued to experience as well as the improvements in his functioning were documented using the **ICF Evaluation Display**, a "before and after" visualisation of Simon's functioning at the the begining and at the end of the Rehab-Cycle®. It also shows whether the goals were achieved. *See "Table 5: ICF Evaluation Display" on page 38 at the end of this booklet.*

The interventions intended to address cycle goal 2 'independence in carrying, moving and handling objects' targeted sense and touch functions, lifting and carrying ability, hand and arm use. Based on a dynamometre analysis, Simon confirmed increases of up to 50% of his pre-Rehab-Cycle values in muscle power in both hands. While this represented a significant gain, Simon's muscle power in the hands was still less than half of the hand force produced by men without spinal cord injury (SCI).

The **combination of weak muscle power and absence of sensitivity made it difficult for Simon to carry out some work tasks** such as exchanging a printer cartridge or rolling up a cable. **Nevertheless, he felt confident in many other daily tasks requiring the use of his hands and arms** such as preparing simple meals.

"While Simon's shoulder mobility, fine hand functions and muscle power improved considerably, his touch functions showed no considerable change since the start of the Rehab-Cycle®. This will limit activities requiring fine hand use."

Simon's physical therapist, at the end of the Rehab-Cycle®

At the end of the Rehab-Cycle® the rehabilitation team evaluated whether the service-program goal they set with Simon i.e. resumption of leisure activities was achieved. Unfortunately, he was unable to fully achieve his hopes of resuming his participation in pre-injury leisure activities. For example, rather than being able to mountain-bike again at the end of the Rehab-Cycle®, Simon was only able to ride a woman's bike, whose frame configuration made it easier for him to mount it. Regardless, **Simon experienced successes in his service-program goal, bringing him closer to his ultimate global goal of community integration without limits**.

Discussion

Rehabilitation incorporating walking as a goal requires both the guidance and support of the rehabilitation team and the focus and determination of the injured person.

Since the severity of spinal cord injury (SCI) and the course of rehabilitation vary from person to person, the assessment of functioning and the selection of appropriate goals, intervention targets and rehabilitative interventions present certain challenges to decision-making in the management of a person's rehabilitation. **Goal-setting, the determination of intervention targets and the interventions to address them involve the rehabilitation team's clinical expertise – clinical reasoning as well as the consideration of the findings of high-quality research.** Rehabilitation professionals are also encouraged to make decisions not only based on their knowledge and experience, but also **take into account the injured person's personal context, needs and wishes** in order to achieve the best possible outcomes.[17,20,21]

Ideally, the selection of interventions should be guided by an evidence-based approach that takes advantage of the best available clinical research on therapies and outcomes. In Simon's case, however, applying an evidence-based approach toward planning interventions to recover Simon's walking ability presented some issues, as meta-analyses of available **research offered only mixed or inconclusive findings on interventions. The limited number of definite recommendations for interventions highlights the need for more quality clinical studies**. The knowledge gained from new and reliable clinical studies would further optimise this rehabilitation process.

Case Study 10 | Walking Recovery | Discussion

"The limited number of definite recommendations for interventions highlights the need for more quality clinical studies."

Simon's case illustrated the rehabilitation management process, in which the recovery of walking ability of a person with an incomplete SCI was a major goal. Recovery of walking ability is complex requiring substantial rehabilitation support. In Simon's case, the Rehab-Cycle® and corresponding ICF-based documentation forms help to facilitate the rehabilitation process.

The Rehab-Cycle® started with an assessment of Simon's functioning. This assessment reflected both Simon's and the rehabilitation team's perspectives. The results of the assessment informed the decisions the rehabilitation team made in consultation with Simon on goals and intervention targets to address in the intervention phase. One of the goals set was 'independence in mobility', specifically recovery of walking ability. In Simon's case, recovery of walking ability was deemed feasible based on the progress made in Simon's medical status and all aspects of functioning before the Rehab-Cycle® started. In addition, relevant research has shown the potential for success in recovering the walking ability of persons with incomplete SCI. [2,3,4]

Once the goals were set and the intervention targets were determined, the next step was deciding on the appropriate interventions to address the intervention targets. At this critical point in rehabilitation planning, the integration of information drawn from research, the knowledge and experience of each member of the rehabilitation team, the injured person's history, and personal resources can facilitate the decision-making process and rehabilitation management as a whole.

In the case of deciding on interventions for the recovery of walking ability, evidence on various intervention approaches is not strong enough to earn a recommendation in a Cochrane review, several studies included in the Cochrane review still found some benefits that persons with SCI could gain from interventions such as resistance and aerobic exercises, Vojta therapy, gait training and physical therapy for improving joint mobility.[15]

In Simon's case, the rehabilitation team considered a mix of interventions that offered him the best chances of improving his walking abilities.

"...while Simon's short-term cycle goals were not quite achieved, the recovery progress that was made was tangible."

At the end of Simon's Rehab-Cycle®, the gains that he made, along with some additional challenges, were clear at the second evaluation of his functioning status. Improvements in areas such as muscle strength, joint mobility, balance and gait pattern were offset by a lack of progress in touch sensitivity, exercise tolerance and control of involuntary movements.

And while Simon's short-term cycle goals were not quite achieved, the recovery progress that was made was tangible. His initial SCI was characterised at admission as ASIA A i.e. complete paralysis below the level of the injury. At the end of the Rehab-Cycle® it improved to normal active movement, full range of motion and full resistance in a functional muscle position for some muscles

i.e. ASIA D. Simon enjoyed the gains he made over the course of his rehabilitation – unassisted walking, riding a bike, driving, to count a few.

In summary, Simon's case has shown that an individualised person-oriented approach that is framed in the ICF-based Rehab-Cycle® and integrates clinical reasoning and evidence from research, can enhance the potential of rehabilitation in the recovery of walking ability of persons with incomplete SCI.

Annex

– *Table 1: Spinal Cord Independence Measure (SCIM)*
– *Table 2: ICF Assessment Sheet*
– *Table 3: ICF Categorical Profile*
– *Table 4: ICF Intervention Table*
– *Table 5: ICF Evaluation Display*
– *Literature*
– *Questions*

Table 1: Spinal Cord Independence Measure (SCIM)

Spinal Cord Independence Measure (SCIM)				
		2 weeks after accident	3 months after accident	5 months after accident
Self-Care	Feeding	0	2	2
	Bathing upper body	0	0	3
	Bathing lower body	0	0	3
	Dressing upper half of the body	0	1	4
	Dressing lower half of the body	0	1	4
	Grooming	0	1	3
	Sub-score	0	5	19
Respiration and sphincter management	Respiration	0	10	10
	Sphincter management-bladder	0	6	15
	Sphincter management-bowel	5	5	10
	Use of toilet	0	0	5
	Sub-score	5	21	40
Mobility in room and toilet	Motion in bed and sore prevention	0	4	6
	Transfers: bed-wheelchair	0	1	1
	Transfers: wheelchair-toilet-tub	0	1	1
	Sub-score	0	6	8
Mobility indoors and outdoors	Mobility indoors	0	3	3
	Mobility for moderate distances	0	1	2
	Mobility outdoors	0	1	2
	Stair management	0	0	2
	Transfer: wheelchair-car	0	1	1
	Sub-score	0	6	10
Total score		5	38	77

Table 1: Spinal Cord Independence Measure (SCIM) scores during the first five months of Simon's rehabilitation

Table 2: ICF Assessment Sheet

ICF Assessment Sheet

Patient Perspective

Body Functions & Structures

- I don't have any sensitivity to temperature from the neck downwards, but reflexes induced by extreme temperature are intact
- I have pain in my right shoulder
- My physical capacity is poorer than before; I reach my breaking point more quickly
- Urination and defecation are good
- I lost 23 kilos, basically muscle mass
- I have poor balance reactions
- My skin is hypersensitive
- Sometimes I have spasms in my legs when I wake up in the morning
- **I have to optimise my gait pattern***

Activities & Participation

- In order to grab objects I need visual control due to the reduced sensitivity in my hands
- **I am not able to run at the moment***
- Driving my car at the moment is not possible; I need a car with automatic transmission
- Daily tasks such as dressing need more time than before, therefore I'm less spontaneous
- I like being in the water but I have to learn to swim again
- I just started to work part-time for my previous employer, and I hope I will be able to work full-time again
- I will go back to live with my mother where I can get assistance for daily tasks if needed
- I want to go to the training centre after discharge
- I want to go mountain biking with my friends
- I can't ride a bicycle at the moment
- As long as I don't have a car, my friends come to see me at home, but I want to go clubbing again

Health Professional Perspective

Body Functions & Structures

- **Respiratory functions – mildly impaired***
- Bowel functions – mildly impaired
- Touch functions below lesion – reduced, especially in the right hand
- **Exercise tolerance functions – mildly impaired***
- Mobility in the right shoulder – reduced
- Muscle mass below the level of the lesion – reduced
- **Muscle power below the level of lesion – reduced***
- **Spasticity in the lower extremity***
- **Involuntary movement reaction functions – reduced***
- **Balance functions – impaired***
- **Coordination of voluntary movements – reduced***
- **Gait pattern functions – impaired***
- **Slight Duchenne-gait on the left side***

Activities & Participation

- Lifting and carrying objects – moderately limited
- Fine hand use – reduced, especially in movements requiring power of the hands and fingers such as opening a tin
- Is able to swim in the supine position but not yet in the prone position
- **Walks only very short distances without devices***
- **Outdoor mobility only in wheelchair***
- **Needs devices to climb stairs***
- **Limitations in driving a car***
- Spends the weekends with his family and meets his friends
- Meets other patients or his therapists in the evening
- Works part-time for his former employer
- Plays table tennis for half an hour every day
- Attends cultural events organised by the Learning-by-Doing Club
- **Managed his first city-training easily***
- Pre-injury leisure activities, such as biking – significantly reduced

Environmental Factors

- Small dose of sleep-inducing medication
- Rectal suppository every morning
- **Elbow crutches***
- **Manual wheelchair for long distances only***
- Supportive family and friends
- Supportive health professional
- Has a case manager at the accident insurance company who is responsible for any financial questions

Personal Factors

- Male, 22 years old
- Family and friends are very important to him
- Has interest in learning about his health condition
- Accepts his fate
- Has clear goals
- Is very ambitious
- Needs physical activity

Table 2: *ICF Assessment Sheet; items in bold lettering followed by a star (*) are related to walking and moving around*

Table 3: ICF Categorical Profile

ICF Categorical Profile												
Assessment												
Global Goal: Community integration without limits												1
Service-Program Goal: Resumption of leisure activities												1
Cycle goal 1: Independence in mobility												0
Cycle goal 2: Independence in carrying, moving and handling objects												1
ICF categories		**ICF Qualifier**									**Goal Relation**	**Goal value**
						problem						
						0	1	2	3	4		
b265	Touch functions										2	1
b28016	Pain in joints										SP, 1, 2	0
b440	Respiration functions										1	0
b445	Respiratory muscle functions										1	0
b455	Exercise tolerance functions										SP, 1, 2	0
b5250	Elimination of faeces										G	0
b710	Mobility of joint functions										SP, 2	1
b7304	Power of muscles of all limbs										SP 1, 2	1
b7305	Power of muscles of the trunk										SP 1, 2	0
b740	Muscle endurance functions										SP, 1	1
b755	Involuntary movement reaction functions										SP, 1	0
b760	Control of voluntary movements										1, 2	0
b770	Gait pattern functions										1	1
d4104	Standing										1	0
d4105	Bending										1	0
d4106	Shifting the body's centre of gravity										1	0
d4154	Maintaining a standing position										1	0
d430	Lifting and carrying objects										2	0
d435	Moving objects with lower extremities										1	0
d440	Fine hand use										2	1
d445	Hand and arm use										2	0
d4500	Walking short distances										1	0
d4501	Walking long distances										1	1
d4502	Walking on different surfaces										SP, 1	1
d4503	Walking around obstacles										1	1
d455	Moving around										SP, 1	1
d4600	Moving around within the home										1	0
d4601	Moving around within buildings other than home										G, 1	0
d4602	Moving around outside the home and other buildings										G, 1	0
d475	Driving										SP, 1	0
d630	Preparing meals										2	0
d850	Remunerative employment										G	1
d920	Recreation and leisure										SP	1
		facilitator					barrier					
		4+	3+	2+	1+	0	1	2	3	4		
e1201	Assistive products...for personal...mobility...										1	4+
pf	Above-average interest in learning about his body											
pf	Has clear goals											
pf	Is very ambitious											
pf	Accepts his fate without questioning											
pf	Charismatic personality											

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 and 2 refer to Cycle goal 1 and 2; SP refers to Service-Program Goal; G refers to the Global Goal; Goal value refers to the ICF qualifier to achieve after an intervention. This table is an excerpt of the full ICF Categorical Profile, only displaying the ICF categories that correspond to any of the goals set.*

Table 4: ICF Intervention Table

ICF Intervention Table													
	Intervention target		Intervention	Nurse	PT	Spo	OT	SW	Others	First value	Goal value	Final value
Activities / Participation	b265	Touch functions	Stimulation with diverse materials				x			3	1	2
	b28016	Pain in joints	Passive movement of the shoulder		x		x			2	0	0
	b440	Respiration functions	Vojta therapy		x					1	0	0
	b445	Respiratory muscle functions	Vojta therapy		x					1	0	0
	b455	Exercise tolerance functions	Endurance training/Arm ergometer training, Gait training outdoors		x	x				1	0	1
	b5250	Elimination of faeces	Medication	x						1	0	1
	b710	Mobility of joint functions	Passive and active movement of the shoulder		x		x			2	1	2
	b7304	Power of muscles of all limbs	Strength training, Vojta therapy		x	x				2	1	1
	b7305	Power of muscles of the trunk	Strength training, Vojta therapy		x	x	x			1	0	0
	b740	Muscle endurance functions	Muscle endurance training		x	x				2	1	1
	b755	Involuntary movement reaction functions	Reaction training		x	x				2	0	0
	b760	Control of voluntary movements	Repetitive training, Vojta therapy		x		x			2	0	1
	b770	Gait pattern functions	Gait training indoors and outdoors		x					3	1	1
	d4104	Standing	Body balance training, Table tennis		x	x				2	0	0
	d4105	Bending	Repetitive training		x					2	0	0
	d4106	Shifting the body's centre of gravity	Repetitive training		x	x	x			1	0	0
	d4154	Maintaining a standing position	Body balance training, Table tennis		x	x				2	0	0
	d430	Lifting and carrying objects	Therapeutic games, daily tasks				x			2	0	1
	d435	Moving objects with lower extremities	Therapeutic games		x					2	0	1
	d440	Fine hand use	Therapeutic games				x			2	1	1
	d445	Hand and arm use	Therapeutic games, water therapy		x	x	x			2	0	1
	d4500	Walking short distances	Gait training outdoors		x					1	0	0
	d4501	Walking long distances	Gait training outdoors		x					3	1	1
	d4502	Walking on different surfaces	Gait training outdoors, city training		x		x			3	1	1
	d4503	Walking around obstacles	Gait training, therapeutic games		x					3	1	1
	d455	Moving around	Gait training outdoors		x					3	1	1
	d4600	Moving around within the home	Daily routine, weekend stay at home						x	1	0	0
	d4601	Moving around within buildings other than home	City training				x			2	0	0
	d4602	Moving around outside the home and other buildings	Gait training outdoors, city training		x		x			2	0	0
	d475	Driving	Driving lessons						x	2	0	1
	d630	Preparing meals	Assistance and instruction				x			1	0	1
	d850	Remunerative employment	Contact with former employer					x	x	2	1	1
	d920	Recreation and leisure	Sport activities		x	x				3	1	2
Environmental factors	e1201	Assistive products... for personal... mobility...	Clarification, counselling and order of devices				x			3+	4+	4+

Table 4: *ICF Intervention Table; PT = Physical Therapist; Spo = Sports Therapist; OT = Occupational Therapist; SW = Social Worker. 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 theses ratings (0 = no problem to 4 = complete problem) in the intervention targets. For the intervention targets representing the environmental and personal factors, the plus sign next to value indicates a facilitator.*

Table 5: ICF Evaluation Display

ICF Evaluation Display																						
		Assessment											Evaluation									
Global Goal: Community integration without limits												1										+
Service-Program Goal: Resumption of leisure activities												1										-
Cycle goal 1: Independence in mobility												0										-
Cycle goal 2: Independence in carrying, moving and handling objects												1										-
ICF categories		ICF Qualifier									Goal relation	Goal value	ICF Qualifier									Goal achieve-ment
					problem										problem							
					0	1	2	3	4						0	1	2	3	4			
b265	Touch functions										2	1										-
b28016	Pain in joints										SP, 1, 2	0										+
b440	Respiration functions										1	0										+
b445	Respiratory muscle functions										1	0										+
b455	Exercise tolerance functions										SP, 1, 2	0										-
b5250	Elimination of faeces										G	0										-
b710	Mobility of joint functions										SP, 2	1										-
b7304	Power of muscles of all limbs										SP 1, 2	1										+
b7305	Power of muscles of the trunk										SP 1, 2	0										+
b740	Muscle endurance functions										SP, 1	1										+
b755	Involuntary movement reaction functions										SP, 1	0										+
b760	Control of voluntary movements										1, 2	0										-
b770	Gait pattern functions										1	1										+
d4104	Standing										1	0										+
d4105	Bending										1	0										+
d4106	Shifting the body's centre of gravity										1	0										+
d4154	Maintaining a standing position										1	0										+
d430	Lifting and carrying objects										2	0										-
d435	Moving objects with lower extremities										1	0										-
d440	Fine hand use										2	1										+
d445	Hand and arm use										2	0										-
d4500	Walking short distances										1	0										+
d4501	Walking long distances										1	1										+
d4502	Walking on different surfaces										SP, 1	1										+
d4503	Walking around obstacles										1	1										+
d455	Moving around										SP, 1	1										+
d4600	Moving around within the home										1	0										+
d4601	Moving around within buildings other than home										G, 1	0										+
d4602	Moving around outside the home and other buildings										G, 1	0										+
d475	Driving										SP, 1	0										-
d630	Preparing meals										2	0										-
d850	Remunerative employment										G	1										+
d920	Recreation and leisure										SP	1										-
		facilitator					barrier						facilitator					barrier				
		4+	3+	2+	1+	0	1	2	3	4			4+	3+	2+	1+	0	1	2	3	4	
e1201	Assistive products...for personal... mobility...										1	4+										+

Table 5: ICF Evaluation Display; 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 and 2 refer to Cycle goal 1 and 2; SP refers to the Service-Program Goal; G refers to the Global Goal; Goal value refers to the ICF qualifier to achieve after an intervention; Goal achievement: + means achieved, - means not achieved.

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Questions

Q1. **What elements of walking ability make it complex?** *(Refer to page 8 for the answer.)*

Q2. **What is the nature and evidence to support locomotor training?** *(Refer to page 10 for the answer.)*

Q3. **Explain the difference between clinical reasoning and evidence-based rehabilitation?** *(Refer to page 12 for the answer.)*

Q4. **After five months of rehabilitation Simon has made tremendous progress. However, he continued to experience problems in mobility. What are they?** *(Refer to page 17 for the answer.)*

Q5. **How can Vojta therapy contribute to the recovery of a person's walking ability?** *(Refer to page 23 for the answer.)*

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