Functional Electrical Stimulation (FES) Cycling Program

- A proposal by Chester Ho and Greg Kern
FES Cycling Program: A Better Future

Problem Identification

The neuro-rehabilitation unit (Unit 58) at the Calgary Foothills Hospital admits approximately 55 spinal cord injury (SCI) patients per year, equivalent to about one per week. Currently, there are over 4000 individuals in Alberta living with SCI and this number is increasing by 140 annually. The options for these patients to pursue an active, well-balanced, healthy lifestyle are limited due to the lack of specialized equipment and services available.

FES (functional electrical stimulation) cycling has been shown to be an excellent cardiovascular exercise for many persons with SCI. In addition, it may have positive effects on the maintenance of bone mass, spasticity and muscle mass, all of which are difficult complications following SCI. Despite the plentiful scientific evidence to support the use of FES cycling for persons with SCI and its widespread use across all major SCI rehabilitation centres in North America, at the moment, there is unfortunately no facility in Calgary that has a FES cycling system. Some people, however, demonstrating a strong demand for this service, own FES bikes in Calgary for their personal use, but with costs exceeding $25,000 per unit, this type of technology is unattainable for the majority of people.

The only option for residents in Southern Alberta to use this type of technology is to travel to Edmonton’s Steadward Centre or Saville Community Sports Centre, or even as far as Regina, Saskatchewan, to be evaluated for their appropriateness and to train on one of them. It is therefore unacceptable that no such program is available at any of the Alberta Health Services rehabilitation sites, including the Foothills Hospital and the Community Accessible Rehabilitation outpatient clinics, or any of the community exercise facilities. Needless to say, there is urgency to rectify this situation.

Seeking Solutions: A Collective Vision

With increasing needs and a greater awareness of the strengths of FES cycling, a compelling vision is unfolding among key stakeholders to empower facilities in Calgary and Southern Alberta to move in the direction of developing FES Cycling Programs. Stakeholders are listening to the increasing demand of people with SCI to provide more technological choices in order to maximize their independence and achieve optimal health and wellbeing.

In response to this collective vision, the SCI Fitness and Wellness Centre of the Canadian Paraplegic Association (CPA) (Alberta) and the Division of Physical Medicine & Rehabilitation (PM&R) at the University of Calgary (UofC) are moving forward to establish FES Cycling Programs. The short-term goal of CPA (Alberta) and the Division of PM&R is to raise capital to purchase 5 RT300-SLSA bikes, in order to facilitate the establishment of an FES Cycling Program in Calgary.

A new model of partnership is unfolding in Calgary to assist clients and solve the problem of gaps when patients are discharged. Currently, there are few consistent rehabilitation therapies after discharge (following the healthcare re-organization by Alberta Health Services in 2007, the Foothills Hospital no longer provides outpatient therapy services in their rehabilitation unit). Thus, people with SCI have few choices once they are back in the community.
The CPA (Alberta) and Dr. Chester Ho, Associate Professor and Head of Division of Physical Medicine & Rehabilitation, Foothills Hospital and Department of Clinical Neurosciences, UofC, are committed to finding solutions and collaborating with our like-minded partners:

- Alberta Health Services (AHS) Tertiary Neurorehabilitation Unit (U58);
- Amanda Project;
- Calgary Health Trust;
- Community Accessibility Rehabilitation (CAR) Clinic;
- Department of Allied Health (Foothills Hospital);
- Department of Physical Education and Recreation Studies, Mount Royal University;
- Faculty of Kinesiology/University of Calgary Rehabilitation and Fitness Program;
- The Steadward Centre, University of Alberta.

**Proposed Project Model**

The model of the FES cycling program in Calgary will be based on the successful model designed by The Steadward Centre at the University of Alberta. The leadership team at The Steadward Centre has graciously agreed to collaborate with the Calgary team to establish an FES cycling program, so that we will become one of their service delivery sites in Alberta, allowing for standardized service design and delivery across the province. Furthermore, the Calgary team will benefit from the many years of experience and expertise in the development of a successful FES cycling program in Edmonton.

The Steadward Centre’s model consists of two main components:

1. The evaluation process; and
2. The community program.

The evaluation process involves the assessment of potential SCI users for the FES bike. This involves medical clearance, therapy evaluation and, for those who are appropriate, the training of the independent use of the FES bike. Currently, this is done at The Steadward Centre in Edmonton. Typically, it takes about 4 sessions to provide the therapy evaluation and training before a user transitions to the community program.

The community program provides the opportunity for the SCI user to independently work out on a FES Bike. This self-directed program will be at locations where FES bikes are available for use as part of their overall fitness training program. Although support may be given from family members or a caregiver, no supervision will be necessary following successful completion of the evaluation process. Just as any fitness training program, there is no restriction on the hours of access or the long-term use of this equipment.
This evaluation and community program model has allowed The Steadward Centre in Edmonton to avoid the creation of a waiting list or “bottle necks” as a result of not having enough community sites.

Specific to Calgary, evaluation and community sites have been identified and commitment has been provided by multiple stakeholders to ensure the success of the FES cycling program:

- **Evaluation sites:**
  - Acute care evaluation site: evaluation will be done by PM&R and the Allied Health team at the FMC for SCI patients undergoing acute rehabilitation; and
  - Outpatient evaluation site: evaluation will be done at the SCI Fitness and Wellness Centre, CPA (Alberta) allowing persons with SCI the opportunity to be evaluated as an outpatient.

- **Community sites:**
  - SCI Fitness and Wellness Centre, CPA (Alberta) (NE Calgary);
  - UofC Rehabilitation and Fitness program (NW Calgary); and
  - Mount Royal University (SW Calgary).

Local coordination of the sites will be provided through the SCI Fitness and Wellness Centre, CPA (Alberta). Each FES bike will be connected via a data line which will be connected to a central server. This will allow central monitoring of FES cycling activities at each site by the local coordinator, as well as allowing personalized stimulation pattern to be accessible to each user, regardless of the site location. Overall coordination and oversight will be provided by The Steadward Centre.

**Proposed Project Processes**

The use of FES Cycling Program involves the following evaluation processes for eligibility and safety determination:

- **Medical clearance** - this is necessary in order to ensure safety for potential users, as the use of FES cycling in inappropriate individuals may potentially cause fractures, skin burns and other adverse reactions. This will be performed by the Physical Medicine & Rehabilitation specialists at the Foothills Hospital; and

- **Therapy clearance** - this involves a trial of FES on potential users, in order to determine user tolerance of the electrical stimulation used, response of the skin and muscles to electrical stimulation and overall user acceptability of the program. This will be performed by the Foothills Hospital therapists and the CPA (Alberta) team.

Referrals are expected to be through these sources:

- Foothills Hospital Unit 58;
- Physical Medicine & Rehabilitation clinics;
- CAR clinics;
- Self-referral from the community to CPA (Alberta); and
- Community partners, e.g. UofC Rehabilitation & Fitness program.

Staffing will be supported by:

- CPA (Alberta) - one kinesiologist has been hired as part of the plan to expand the SCI Fitness and Wellness Centre. She has already completed the online training for FES cycling;

- Division of Physical Medicine & Rehabilitation - all 4 SCI Physiatrists (Denise Hill, Chester Ho, Dan McGowan and Gillian Simonett) endorse this program and will provide medical screening prior to the SCI persons' enrollment to this program;

- Alberta Health Services - Allied Health manager for neuro-rehabilitation (Josh Bashow) is supportive of this program and will work with his therapy staff at the Foothills Hospital to provide FES therapy screening; and

- Community partners will not have direct staffing needs as no user supervision is required at the community sites. However, their staff will be given the appropriate training so they know who to contact at CPA (Alberta) in case of any equipment or user issues.

This proposal will involve Phase I and Phase II. Overall planning and implementation of the proposal will be overseen by The Steadward Centre team. Funding will be used towards the equipment, routine maintenance and training costs while operating costs will be provided by CPA (Alberta), Division of Physical Medicine & Rehabilitation and Alberta Health Services through staffing support. Appropriate space will be provided by the community sites.

### A. Phase I

The goal of Phase I is to evaluate and show the feasibility and demand of FES cycling in Calgary. We anticipate Phase I to last for about 1 year. During Phase I, one FES bike will be installed at the Foothills Hospital while two will be installed at the SCI Fitness and Wellness Centre, CPA (Alberta). One of the two FES bikes at the CPA (Alberta) location will be used for evaluation purposes while the other FES bike will be for community use. Therefore, CPA (Alberta) will have a dual role as both evaluation and community sites. This Phase will also help us gain experience with the logistics of the installation of the FES bikes in Calgary, before we install the FES bikes in the Community sites in Phase II.

By having an FES bike located at the Foothills Hospital, all persons with a new SCI will be screened by the rehabilitation team (Physiatrists and Allied Health therapists) for eligibility and medical appropriateness for the use of FES cycling before their discharge from acute rehabilitation. The Foothills Hospital SCI rehabilitation team will work collaboratively with the CPA (Alberta) team and the community sites, ensuring that those SCI individuals who are appropriate will benefit from the use of FES cycling and have the opportunity to begin FES cycling shortly after their discharge from Unit 58.

There will also be persons with SCI in the community who may be interested in FES cycling and may benefit from it. They can be screened at the Foothills Hospital Physical Medicine & Rehabilitation SCI Clinics, with subsequent evaluation and training at the SCI Fitness and Wellness Centre, CPA (Alberta).
Subsequent community use will be available at the CPA (Alberta) site or other community sites, once they are up and running.

This arrangement will ensure that no “bottle neck” will be created by clearly delineating the evaluation and community sites – this has already been demonstrated by The Steadward Centre program in Edmonton.

Evaluation of Phase I

Success of Phase I will be evaluated by its capacity, user satisfaction and physiologic improvement of users:

1. Capacity

We anticipate the following capacity by the end of Phase I:

- 22 persons with SCI will be screened and admitted to the program.

  Rationale: Over a typical 12 month period, the rehabilitation unit 58 of the Foothills Hospital admits approximately 55 SCI patients – equivalent to about 1 per week. We expect approximately half of those patients will be suitable to use the cycling equipment (leg and/or arm). Therefore, by the end of the first year, approximately 25 patients would be eligible to use the FES equipment as in-patients. Assuming around half of them are interested we estimate 12 new in-patients per year using the equipment and then referred to the program at CPA (Alberta).

  Additionally, we anticipate another 10 SCI patients per year from the community being screened and admitted to the program.

Given the experience in Edmonton, we anticipate that by the end of Phase I, we will most likely reach capacity with the number of evaluation and community sites proposed.

2. User satisfaction

This will be evaluated by standard surveys to determine the users' experience with the FES Cycling Program. We will use these results to guide the development of Phase II.

3. Physiologic improvement

Exercise training response will be measured at baseline of the program as well as at the end of the first year, in order to determine any improvement in the physiologic response of the users.

B. Phase II

Phase II will most likely begin in year 2, and will focus on the development of FES cycling programs in other community fitness centres such as the Mount Royal University SCI Fitness Program and the University of Calgary Rehabilitation & Fitness Program. Not only will this community implementation meet the capacity issue that we will likely encounter in Calgary, but also to provide easier geographical
access to the use of this exercise modality to persons with SCI. We plan to have 2 FES bikes installed during this phase (one at Mount Royal University and one at the University of Calgary).

**Benefits**

The benefits of a FES bike for people with spinal cord injuries and other disabilities are plentiful. Over the past 20 years, research has repeatedly supported numerous physical benefits to spinal cord injury patients (Davis 2008), such as:

- Improvement in cardio-respiratory fitness from increased movement and physical activity (Hooker 1995);
- Reduction in spasticity (Krause 2008);
- Maintaining muscle bulk (Scremin 1999);
- Prevention of further disuse atrophy (Baldi 1998);
- Prevention of bone mass loss;
- Increasing local blood circulation;
- Increasing satisfaction and quality of life for SCI individuals through physical activity, involvement in community exercise, interacting with other participants and being closely followed by one of our Specialized Fitness Coordinators; and
- Reduction in long-term cost for the health care system and the participant.

**Product Description**

- RT300-SLSA FES Leg cycle c/w 6 channel E-stimulation
- NEW 10” Sage controller
- All cables
- Adjustable pedal set
- Height adjustment
- Wheel chair leg rests
- 5 Sets of Electrodes
- Complete setup including:
  - equipment
  - consultation on configuration
  - monitoring & reporting for 2 years
  - initial training should cycle be in a clinic setting
- 2 years parts and labor service
- System investment $23,740
- Shipping and handling and brokerage fees $990
- Training $1,000
- Total $25,730
## Estimated Statement of Earnings, Capital Costs for FES Cycling Programs

*Foothills Hospital, Sci Fitness and Wellness Centre (CPA) Alberta, MRU and UofC Rehabilitation and Fitness Program*

<table>
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