Imagine being able to pace the brain, to alter brain function only in the focal area that needs to be altered. This is exactly what therapeutic brain stimulation does and it is the most exciting new treatment for Parkinson’s disease and other movement disorders developed in the past 15 years (see insert).

Like a heart pacemaker, the brain pacemaker uses small electrical pulses to readjust the activity of brain cells that send the wrong signals to muscles. Although we do not know exactly how electrical impulses alter brain function, we are now able to pinpoint the precise location of the abnormally firing brain cells that cause muscle stiffness and tremor. Unlike medication, the brain pacemaker targets a very small and specific brain area, which causes little disruption in other brain functions. Parkinson’s patients with the Brain Pacemaker can reduce their medications by half, thus, minimizing the side effects of drugs.

The Brain Pacemaker has already revolutionized the treatment of movement disorders and in the future will completely alter the management of other disabling conditions. Our AIMS are to learn exactly how electrical stimulation normalizes brain function, to develop better technology for the device and other neural prosthetics, test these systems for new conditions, and thus improve patient’s quality of life.

The Calgary Neuromodulation Program
At present the largest experience with Brain Pacemakers has been in the treatment of movement disorders, such as Parkinson’s disease, tremor and dystonia. About 75 patients have had Brain Pacemakers implanted in Calgary.

Our team has already brought new and innovative technologies to Albertans. For example, we led a multicentre Canadian trial of Brain Pacemakers for cervical dystonia which has changed the way patients with this condition are treated in Canada. We have started a similar study of Brain Pacemakers for epilepsy and are involved in another trial of electrical stimulation for pain and chronic migraine. During the past several years, we have received peer-reviewed funding from numerous national and international agencies. In addition, the generous support provided by community organizations and from many caring individuals have made Calgary a centre of excellence.
Research and Technology
Innovative research and technology are the keys to the success of Brain Pacemaker therapy. Our goals over the next five years are three-fold:

1. To learn exactly how the Brain Pacemaker works at the level of cells and circuits within the brain
   A thorough understanding of how the brain pacemaker works on brain cells and normalizes brain function is critical to the future success of this technology. Abnormal rhythmic brain cell firing are at the root of many movement disorders and other neurologic conditions. Therefore, a dedicated human and animal research laboratory will determine how therapeutic stimulation effects individual brain cells, and what improvements are seen in patients with Brain Pacemakers.

2. To develop the next generation of Brain Pacemaker technology
   Current stimulators require stereotactic minimally-invasive surgery to implant the electrodes and a second surgery under general anaesthetic, to connect the electrode to the generator (pacemaker). Industry is working on a second generation of Brain Pacemaker: a wireless and rechargeable system. Despite some advantages of such a system the real advance will occur when the stimulator becomes a "smart" device, one that can sense abnormal brain firing and suppress abnormal activity only when required, in other words, work on demand!

3. To apply the Brain Pacemaker to treat other neurologic and psychiatric conditions
   Many conditions result from disorganized brain firing, including dystonia, epilepsy, obsessive-compulsive disorder, refractory depression, chronic pain and perhaps even addiction, obesity and other eating disorders. The Brain Pacemaker has tremendous potential to treat these conditions. In Calgary we are assembling a world-class team of translational neuroscientists who are investigating this possibility. Animal models of these diseases will be used to locate the site(s) of abnormally firing neurons and test whether electrical stimulation at these locations is safe and effective in restoring normal brain function. The knowledge derived from these pre-clinical studies will then be used to guide Brain Pacemaker placement in human clinical trials.

Impact of the Brain Pacemaker on Health Care and your Community
- To improve the quality of life of Albertans living with neurologic and psychiatric conditions
- To enhance recruitment of highly qualified individuals, as Alberta will lead the field of neural prosthetics and therapeutic brain stimulation
- To train new generations of physicians, surgeons, physiologists, physicists, computer and biomedical engineers

How to help
- The Brain Pacemaker program is part of REACH, the joint fund-raising initiative of the Calgary Health Region and University of Calgary
- If you have questions regarding this program, please call 403-220-5572
- If you would like to donate, please send a cheque to the Therapeutic Brain Stimulation and Research Program, University of Calgary, rm 182A HMRB, 3330 Hospital Dr. NW, Calgary, Alberta T2N4N1
- Charitable receipts are provided by the University of Calgary