

Sister Kenny Research Center Briefing

Sister Kenny Research Center Innovation to Improve Patient Outcomes

A vision becomes reality

Sister Kenny Rehabilitation Institute's legacy of innovative rehabilitative research began with its founding when Sister Elizabeth Kenny developed novel treatments for paralytic polio that challenged prevailing medical paradigms and transformed methods of rehabilitation.

Rehabilitative research reached new heights in November 2008, when the Sister Kenny Research Center (SKRC) opened its 5,272 square foot facility at the Sister Kenny Rehabilitation Institute (SKRI) on the Abbott Northwestern Hospital campus.

In 2007, after a two year fundraising campaign, co-chairs Mary Lee Dayton and Tom Borman along with their committee announced the successful completion of a \$2.8 million campaign. Under the extraordinary leadership of Dayton and Borman, the campaign exceeded goal by 11%. "Research is

a critical component of providing the best patient care, and we have, thanks to the support of generous benefactors, established a world class rehabilitation research facility in our own community," remarked Dayton.

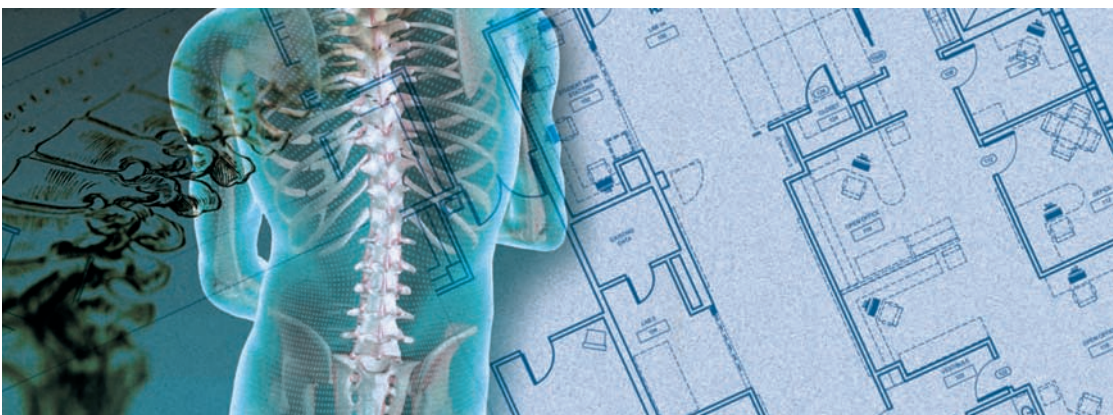
The campaign's success turned a long time vision into reality. With the August 2007 recruitment of Lars Oddsson, PhD, director of research, and the opening of the Research Center in November 2008, SKRC has achieved significant milestones; established educational and entrepreneurial collaborative relationships, and secured federal funding, while charting its course for the future.

Milestones

Oddsson recounted the milestones achieved by the Research Center during its first two years:

- constructed the 5,272 square foot Research Center.

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SISTER KENNY
REHABILITATION
INSTITUTE
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Innovation *(continued from cover)*

- established research faculty of 20 active clinical scientists, including therapists and physicians, who are engaged in research.
- submitted 10 federal research grant requests totaling \$6.5 million, of which nearly \$1 million has been funded and more than \$2.5 million is pending.
- published more than 20 peer-reviewed papers.
- submitted 15 abstracts and conference presentations.
- mentored nearly two dozen undergraduate and graduate students on rehabilitation design projects.
- formed two start-up companies and submitted a utility patent with pending status.

“Philanthropic support has been a vital component of our earliest successes,” exclaimed Oddsson. “Campaign contributions funded operational expenses, like salary costs, before extramural funds were secured. Additionally, donations funded the construction of the Research Center,” added Oddsson.



Lars Oddsson, PhD, Director of Research

Sister Kenny Research Center (SKRC) was very fortunate to recruit Lars Oddsson, PhD, as its director of research in 2007. Oddsson brought a wealth of training, experience and valuable relationships to his position, and he served a crucial role in the creation of the SKRC facility.

Born in Iceland and raised in Sweden, Oddsson received engineering training at Linköping University and his doctorate in medical sciences at the Karolinska Institute, both in Sweden. He has a broad background in physiology, engineering, rehabilitation sciences and technology development. He has served as principal investigator and has authored numerous articles on a variety of biomechanical, sports medicine and rehabilitation studies. He has received funding from several private and federal institutions, including the National Institutes of Health, Whitaker Foundation, Veteran's Administration, NASA, the Karolinska Institute and The Retirement Research Foundation. Prior to his current position, Oddsson was

a research professor at Boston University's NeuroMuscular Research Center for 14 years.

In addition to the broad national and international network of collaborators he has linked to SKRC, Oddsson has engaged the Research Center with a unique graduate student program — PIEp — that brings bright young minds to SKRC, as they work to bring their ideas for new rehabilitation technologies to fruition. *(See article on page 6.)*

"Establishing the Research Center at Sister Kenny Rehabilitation Institute has been an exciting challenge. I am very proud of the Research Center's accomplishments to date. I look forward to contributing to the excellence that the Institute offers to the community by engaging with clinicians, patients, donors and other stakeholders to improve patients' lives through innovation and research," remarked Oddsson.

Physical environment breeds culture of collaboration

Upon the opening of SKRC in 2008, Karl Sandin, MD, MPH, physician-in-chief, Sister Kenny Rehabilitation Institute, said, “Our design of the Research Center doesn’t stand apart from patient care. In fact, it is an integral part of the patient care experience. Our reasons for launching the Research Center are simple: to help people function and perform better in their daily lives and to have a better outcome from their care at the Institute.”

According to Lars Oddsson, director of research, the SKRC laboratory space was designed to be an integral part of Sister Kenny’s inpatient care areas. “A great strength of the SKRC is its physical proximity to patients and practicing clinicians,” said Oddsson.

The Research Center location, immediately adjacent to the Institute’s patient care area, provides critical access to the expertise of clinicians. The proximity to patient care enables greater efficiencies in conducting pilot studies, where findings and nimble responsiveness are critical to competitive grant submissions.

SKRC’s physical plant includes a design lab with electronics and mechanical design-build capabilities; three additional research labs, including a gait analysis lab; plus office space for core employees and work stations for clinicians and students involved in research projects. “This shared environment fosters a culture of research and innovation to address important clinical needs,” said Oddsson.

“Because of our location, we can respond to immediate needs of patients, as indicated by Sister Kenny clinicians, and we can focus our research around identified needs. Many of our researchers are actively involved in clinical care, so what they learn in research can have an almost immediate benefit to patients,” added Oddsson.

Maggie Weightman, PhD, PT, assistant scientist, who is working on several projects for the Department of Defense, also practices as a physical therapist. “The proximity of the

Research Center to patient care areas allows me to conduct research, mentor clinician researchers and continue one of my favorite activities, which is to care for patients,” noted Weightman. She is currently mentoring Kevin Komenda, PT, on a Sister Kenny Foundation funded project involving stroke survivors with significant balance issues.

Mary Radomski, PhD, OTR/L conducts research directly related to SKRI patients. She is now recruiting stroke survivor volunteers as they are discharged from the hospital, to assess how strictly they adhere to therapy recommendations. She is also collaborating with Chris Tripp, MS, OTR/L, instructor scientist, on a study to examine self-identified rehabilitation needs and goals of outpatients with brain cancer.

Collaborative relationships are also part of the culture at SKRC and are critical to the center’s success. Since its inception, SKRC has or has had collaboration initiatives with Hamline University and the University of Minnesota. At a national level, the SKRC has engaged and worked with the United States Department of Defense, researchers at the University of Michigan, the University of North Carolina, the Veteran’s Administration and the University of Missouri Center for Lymphedema Research. The Research Center’s international partners include:

- Ben-Gurion University, Israel
- Comenius University, Slovakia
- Delft University, the Netherlands
- Karolinska Institute, Sweden
- Product Innovation Engineering program, Sweden
- Royal Institute of Technology, Sweden
- Sapporo Medical University, Japan
- University of Toronto, Canada

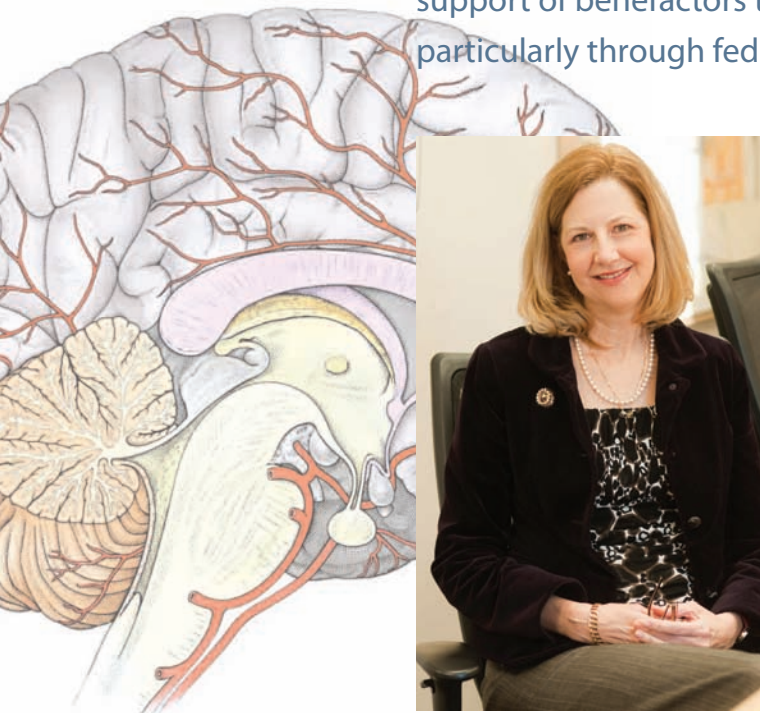
These collaborations and recognition of the Research Center as an up-and-coming research institution have resulted in invitations to present and chair sessions at several national and international conferences.

“A great strength of the SKRC is its physical proximity to patients and practicing clinicians.”

—Lars Oddsson, director of research, SKRC

Extramural funding is crucial to research

In addition to the investment of many campaign donors and the continued support of benefactors to the Sister Kenny Foundation, extramural funding — particularly through federal grants — is extremely important to the SKRC.



Mary Radomski, PhD, OTR/L, occupational therapist with SKRI for more than 30 years and assistant scientist, said, “In 2007, while working on my dissertation for my doctorate at the University of Minnesota, I was contacted by leaders of a newly formed division within the Army Office of the Surgeon General, now called the Rehabilitation and Reintegration Division. At that time, they were looking for subject matter experts in the area of rehabilitation after mild traumatic brain injury (TBI), which is my area of clinical expertise.” Thus began the collaborative work, which continues at present. In 2010, approximately 85 percent of Radomski’s salary was funded by the Department of Defense.

The work funded by the Department of Defense includes:

A fellowship that focuses on identifying and disseminating best practices for occupational

therapy and physical therapy specific to soldiers with mild TBI/concussion. Both Radomski and Maggie Weightman, PhD, PT, assistant scientist, have fellowships with responsibility to identify evidence-supported practices, use that information to develop a toolkit that documents occupational and physical therapy best practices for soldiers with mild traumatic brain injury and present findings at conferences for military clinicians.

Evaluation and impact of mCare, a cell-phone based bi-directional messaging system, on the case management care of traumatic brain injury patients assigned to the Community Based Warrior Transition Units. A Telemedicine-TBI study funded by Army Telemedicine and Advanced Technology Research Center, mCare is a newly developed software tool that can be downloaded onto patients’ (service members) phones. Many service members receive their medical and rehabilitative care in their home

communities; and through mCare, case managers can send actionable prompts and conduct real-time assessment and support.

Radomski and Matthew White, OTR/L, instructor scientist, serve as subject matter experts on this project because of their past work at SKRC involving the use of smart phones to help patients follow through on therapy recommendations.

Combat Readiness Check: Development of a dual-task assessment protocol to assist with return-to-duty decision making after TBI.

This project is funded by the U.S. Army Medical Research Material Command. Maggie Weightman, PhD, PT, assistant scientist, is co-principal investigator on this project with Radomski.

It is estimated that as many as 22% of the two million service members who have been deployed to Iraq or Afghanistan have experienced a mild TBI or concussion as a result of being injured by improvised explosive devices. If service members are returned too soon to duty, they may not be able to handle the demands of their duty which could jeopardize their safety, the safety of others and

compromise the military mission. This grant funded the development of assessment tasks that are based on military dual-task and multi-task scenarios to test service members with mild TBI. A proposal for nearly \$1 million has been submitted for three-year funding to refine the tasks, assess reliability and preliminary validity of the assessment protocol. If funded, the project will involve partnerships with the Minnesota National Guard, Minnesota Veterans Administration and Fort Bragg, one of the United States' most combat ready and active military installations.

“Knowledge is developed through a series of studies,” says Radomski. “You begin with an interesting concept and develop a pilot study to test it, then the idea needs to progress into a larger study to have the concept tested more thoroughly. This is the step where additional funding is needed, such as that provided through federal grants.” The Sister Kenny Foundation has as its priority to fund pilot research studies that remain critical to the success of the SKRC and to the ultimate goal of creating new knowledge to inform practice.

The collaboration between SKRC and the Department of Defense works to support U.S. soldiers who have experienced mild traumatic brain injury.

Sister Kenny Research Center Vision

To be an internationally recognized institution of excellence across a broad area of rehabilitation research with a focus on neurorehabilitation with a technology emphasis; to produce related experimental, clinical and translational research that can enhance patients' quality of life through effective evidence-based treatment procedures.

To provide a rewarding environment that attracts top research scholars, clinicians and staff to work effectively and collaboratively in an interdisciplinary manner, with excellence in mentorship and access to research tools required for a perpetually successful research legacy.

PIEp brings engineering students from Sweden to SKRC

PIEp does not focus on one particular scientific area; rather, it enables projects and activities to cross several disciplines, where areas such as engineering design, innovation management, new product development, change management and industrial design are all highly relevant.

The Product Innovation Engineering program (PIEp) is a Swedish program initiated in 2007 as an academia-based effort to promote research and education that would have significant impact on increasing innovative capacity in Swedish universities and industrial organizations. PIEp builds on a strong competence base in product development research, including both managerial and technical aspects. PIEp does not focus on one particular scientific area; rather, it enables projects and activities to cross several disciplines, where areas such as engineering design, innovation management, new product development, change management and industrial design are all highly relevant.

PIEp partners graduate students with research institutes around the world to promote innovative product and business development. In addition to six Swedish sites, there are five international partners:

- Sister Kenny Research Center, Minneapolis, Minnesota
- Stanford University Center for Design Research, Stanford, California
- Engineering Design Center, University of Cambridge, Cambridge, UK
- Institute of Product Development, Technical University of Munich, Munich, Germany
- Design Center at Aalto University, Helsinki, Finland

PIEp brings the brilliance and enthusiasm of young scientists to SKRC. “I love to work with the students,” said Lars Oddsson, PhD, SKRC director. “They have great ideas and are on top of the latest trends. These students have been raised on technology, plus they are using the latest and greatest technology in the educational system. That’s what they bring to the table.”

The benefit of the PIEp is best exemplified by the graduate students participating in the program:

Katarina Lund, MS (2008-09)

“I was one of the first students to go to the Sister Kenny Research Center for my master’s thesis,” said Lund. “Originally, my thesis was going to be



a work model for innovation projects at SKRC, my task being to consider and assess all things innovative — beginning with the physical workspace. But it quickly became clear

that something more was needed, something that would be a resource beyond my six month internship at SKRC. Shortly after my arrival in October 2008, the idea of the *Innovation Handbook* was born and I never looked back. By February 2009, the handbook was printed!”

This handbook is now a manual outlining a novel transdisciplinary innovation process for faculty and students at SKRC. It has generated strong interest from the local medtech industry. Furthermore, its translation into Japanese has been requested by visiting researchers and entrepreneurs from Japan’s Kansai region.

Daniel Nilsson, MS (2008-present)

“My involvement with PIEp began during the last year of my education in Sweden,” said Nilsson. “The first project with SKRC was a balance assessment device called the StepWiz. By measuring the time it takes to initiate a step off this device, we can predict

patients' risk of experiencing future injurious falls," he added.

"SKOTEE was the second project that I worked on, a home telerehabilitation system that provides adherence and motivational support to patients in their homes," said Nilsson. SKOTEE is a robot system and exercise device that communicates with a main robotic platform. The system allows a clinician to track patient progress and schedule patient tasks from a remote website. "My role initially," added Nilsson, "was to lead teams of students from the University of Minnesota and Royal Institute of Technology (Sweden). This work provided the foundation for my master's thesis on Globally Distributed Design Teams. After the student project in developing the technology was finished, I continued working with the technology and implemented further improvements to the robotic platform. I'm sure this would not have been possible without the support of PIEp," he concluded.

Nilsson's current focus is on a small start-up company at SKRC surrounding the development of a wearable balance prosthesis device, which is referred to as the SmartSock.



Anna-Sara Nilsson (2010-11)

"I arrived in September 2010," said Nilsson, "having learned about PIEp while attending the Royal Institute of Technology in Stockholm, when Dr. Oddsson visited. I am developing a glove-like device designed to help patients open their hand following a stroke or other neurological or musculoskeletal condition." The glove is designed to open the hand and allow the patient to do functional exercises, such as grabbing and releasing objects.



A goal of the glove design is to maximize comfort with construction that minimizes patient strain using gentle fabric to minimize friction and eliminate skin irritations. In turn, the patient will be able to maximize the amount of time that they use the product. Use of this innovative exercise glove is particularly important to stroke patients during their earliest stages of recovery to achieve full function.

Nilsson is gratified by her accomplishments, "Leading this project, as a graduate student, has been a quality learning experience. Our research team has found some unique solutions as we work to actualize the glove. While I strive to develop a project to benefit future patients, this experience will benefit me in the future, as well."

Commercialization — *bringing innovation to market*

For research to bring wide-reaching improvements to patient outcomes, there must be a strong synergy with the business world. Among its achievements, SKRC has a utility patent pending on one of its projects and two start-up companies existing within its walls.

Dana Boyle serves as vice president of community engagement at LifeScience Alley, a nonprofit trade association to support Minnesota's health care industry. She comments, "We all know there is a need for better products, services and solutions ... Innovation these days involves listening to the patients and deeply and intimately understanding their personal needs."

Dale Wahlstrom, CEO of LifeScience Alley and the BioBusiness Alliance of Minnesota, an industry-led, not-for-profit organization dedicated to the advancement of bioscience-based businesses in Minnesota, commented that "Minnesota is, as I think all Minnesotans know, a real mecca for the development and manufacturing of medical devices, and specifically for device-based technology, but also for health care delivery as well as supporting diagnostic technology." As SKRC develops its technologies, it has access to local experts and industry to help bring products to market.

Promising patient-centered technologies currently being developed at SKRC

The StepWiz measures one's ability to quickly execute a step under cognitive stress.

StepWiz

The StepWiz is a slim electronic pressure platform, about the size of a laptop computer, that measures one's ability to quickly execute a step under cognitive stress. Oddsson's research has demonstrated that an individual's ability to execute a step is a reliable and repeatable indicator of future falls and is sensitive to functional balance training. This device is currently being used in a Sister Kenny Foundation funded research project evaluating the risk of falls in SKRI patients following hospital discharge, lead by Carolyn Holm, PT, instructor scientist. The StepWiz will be utilized in a proposed Balance Improvement



Program which the Research Center plans to launch in 2011.

SKOTEE

A robot named SKOTEE (Sister Kenny hOme ThErapy systEm) is a great example of what is possible when the SKRC staff and engineering students team up. According to Matt White, OTR/L, instructor scientist, “About two years ago, we got the idea to build a socially assistive personal robot to help patients in the home environment. SKOTEE is an R2D2-like robot with touch screen



SKOTEE is a personal robot to help patients in the home environment.

controls that will remind patients to conduct their exercises, take their medications and keep their medical appointments. An exercise apparatus — much like a car’s stick shift — is designed to interact with SKOTEE allowing patients to exercise their affected arm. “It operates much like a video game, motivating patients and providing them with companion-

ship and entertainment. It even plays audio books,” added White. SKOTEE has the potential to improve patients’ functional abilities from the comfort of their home. Telemedicine increases accessibility to health care while decreasing the cost and time involved in clinic visits.

“With funding from the Sister Kenny Foundation, a group of patients who need to practice arm movement will serve as our focus group,” said White. “Each patient will independently interact with the robot in a home simulated environment and then complete a questionnaire evaluating ease and comfort of use along with overall satisfaction.” SKOTEE was primarily developed by two groups of engineering students, one from the University of Minnesota, the other from the Royal Institute of Technology in Sweden, with Daniel Nilsson, PIEp graduate student, coordinating the effort as part of his master’s thesis and Oddsson serving as the mentor.

A U.S. utility patent and an international patent have recently been filed for SKOTEE.

SmartSock

“Technology today is becoming smarter, smaller, less expensive, easier to access — even wearable,” said Lars Oddsson, PhD, SKRC director. An example of this is the SmartSock, a special sock designed to help patients who are at risk of falling, learn to maintain their balance while standing. Sensors in the sock measure foot pressure and, through a series of vibrations, train patients to stand and walk in a safer manner. This product was initially brought to SKRC by Oddsson from his most recent position at Boston University and the company that holds the pending patent, RxFunction, now exists within SKRC. Dan Leach, CEO of RxFunction, is involved on a daily basis in the development of the SmartSock.

Continued on back cover

Commercialization *(continued from page 9)*

The combined role of clinician/researcher, that many of the Research Center’s faculty share, provides the benefit of directly hearing what patients want and having the resources to act. This level of service is what differentiates Sister Kenny Rehabilitation Institute from many other rehabilitation providers.



The SmartSock is designed to help patients who are at risk of falling learn to maintain their balance while standing.

Flamingo

When Oddsson came to SKRC in 2007, he also brought with him the Gravity Bed — now called the Flamingo — that helps patients regain their balance following a stroke or another balance-altering condition. The Flamingo provides a virtual reality environment that makes patients feel they are standing, even though they are lying on their back. It allows movement from side to side and up and down as if walking, but with varying degrees of gravity-like load.

Members of a stroke support group were asked to provide design suggestions. Cheryl Smith, stroke survivor, noted, “The engineers took into consideration that the user will have physical limitations, so the Flamingo must be

safe and easy to operate.”

Oddsson is optimistic about the Flamingo’s future. “It explores our evolving model of technology commercialization — growing a product line within the Research Center that could potentially be commercialized to help patients.”

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The Flamingo helps patients regain their balance following a stroke or other balance-altering condition.

Sister Kenny Research Center Briefing 2011

If you have a specific question or comment about the Sister Kenny Research Center, please contact Lars Oddsson, PhD at Lars.Oddsson@allina.com or 612-863-7607.

You may also visit www.sisterkennyinstitute.com