



Report on
Rehabilitation
Research



Welcome
home

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Funding 2009-2010

Ontario Ministry of Health and Long-Term Care	\$ 3,000,000
Toronto Rehab Foundation	\$ 1,100,000
External Research Grants	\$ 5,931,733
Total	\$10,031,733

(does not include infrastructure awards)

Publications

Book sections	3
Journal articles	254
Total	257

Research Ethics Board (REB)

Oversight of current studies	190
Independent ethics assessment of new proposals	74



On the cover:

Finding ways for people with disabling injury and illness to exercise safely in the community is an intense area of activity for Toronto Rehab researchers (see The exercise challenge on page 26). Here, Susan Marzolini, rehab supervisor, clinical research coordinator and PhD candidate, and scientist Dr. Paul Oh, evaluate a participant in a unique outpatient program for stroke survivors. Participants work out once a week at Toronto Rehab and then another four times weekly at home. Results show measurable improvements in overall fitness levels.

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The comfort of home getting the support you need

- + Staying at home: big ideas and smart solutions
- + Informal caregivers: a “threatened resource”

Developing technologies for people like Koi Fung Quan, 83, to ‘age in place’ is a big focus at Toronto Rehab. Scientists are devising practical solutions to assist older people in day-to-day living and help them stay longer in their homes. Pictured here are Dr. Geoff Fernie, vice president, research, with Technology Team members Rosalie Wang (seated at front), Dr. Jennifer Campos, and Tilak Dutta (standing).



Staying at home big ideas and smart solutions

Introduction by Dr. Geoff Fernie, VP, Research

How many times have you heard someone say: “I can’t see myself moving into one small room in a nursing home. I want to stay at home with my things around me—where my family and friends can come and stay.”?

Many of us feel the same way. It’s certainly the view of most baby boomers who will start reaching retirement age in 2011. A recent survey by Living Assistance Services found that 70 per cent of Canadians want to ‘age in place’.

It’s not realistic anyway to think we could afford to build enough nursing homes for the coming wave of older Canadians. The number of people over the age of 65 will double in the next two decades.

But how realistic is it to imagine people staying in their own homes as they experience the effects of aging? Consider that about 90 per cent of those over age 65 have at least one chronic disease, while 80 per cent have at least two chronic diseases.

Also consider that staying at home often means relying on family and friends for help. An

estimated three million Canadians voluntarily provide care to others. And this can place major stresses on those ‘informal caregivers’.

So the big question is how to support people in their own homes as they age, and how to ease the demands on informal caregivers (see *Informal caregivers: a “threatened resource”* on page 5).

At Toronto Rehab, researchers are coming up with answers. In this report, we spotlight some of our best ideas to help people stay independent as they grow older. These approaches can also assist individuals of all ages who are living with disabling injury and illness.

You will read, for example, about ‘intelligent’ technologies and safety-enhancing devices for the home. But no one wants home to mean housebound. So we’re also developing new approaches, even better non-slip winter footwear, to help people get out and about. Much of our work is about preventing disability and keeping people safe at home.

For those who’ve already experienced disability or disease, our scientists are devising strategies for keeping people out of hospital. This may mean programs that reduce the risk of recurrence and can be done close to home. Or new technologies to detect sleep apnea at home and prevent strokes and other common consequences of untreated sleep apnea.

For those already in hospital, we want to maximize the extent of recovery from injury and illness. Getting people home from hospital in better shape means a stronger re-entry into daily life. It also requires making hospitals safer

with technologies that increase hand washing so that discharge is not delayed by acquiring infections while in hospitals. We’re also identifying ways to support people once they return home—such as an innovative telephone-based therapy for brain injury survivors.

And for people for whom home is not an option, Toronto Rehab research is contributing to improvements in long-term care.

Our work has practical implications for people, and for the delivery of healthcare. We’re working hard to get our best ideas and innovations out of the lab and into widespread use. This report describes some of the ways in which our research is already influencing healthcare and stimulating the economy.

Assistive technologies, devices and products are now starting to reach the market where they can benefit all kinds of people.

It’s an amazing research group gathered here at Toronto Rehab. Launched

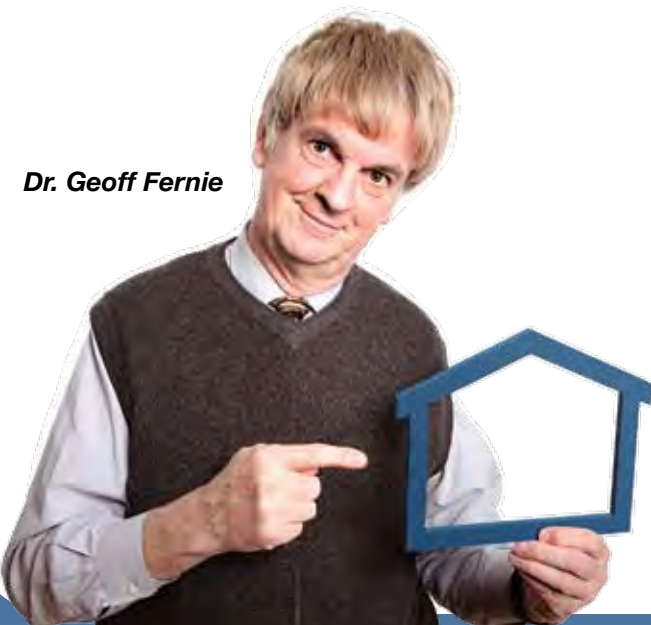
nine years ago—hence the title of this report, +9—with a grant from the Ontario Ministry of Health and Long-Term Care (MOHLTC), we are now the second largest rehabilitation research program in the world. The quality of our research is thanks to an exceptional team of researchers, clinicians, students, trainees and support staff. Many are cross-appointed to the University of Toronto, our valued affiliate, and to other leading academic institutions.

Fuelling our research is the support of the MOHLTC, and other ministries, agencies and foundations. These include the Ontario Ministry of Research and Innovation, the Ontario Innovation Trust, the Canadian Institutes of Health Research, the Canada Foundation for Innovation, and the Ontario Neurotrauma Foundation, among others. Also indispensable are the donations of generous individuals who contribute to our research through the Toronto Rehab Foundation.

This investment makes it possible for us to produce solutions to pressing problems—and to find ways for people to remain independent as they cope with the often daunting challenges of aging and disability.

“The big question is how to support people in their own homes as they age, and how to ease the demands on informal caregivers.”

— Dr. Geoff Fernie



Dr. Geoff Fernie

Informal caregivers a “threatened resource”

An interview with Dr. Adalsteinn Brown

Dr. Adalsteinn Brown has experienced first-hand the rewards and challenges of being an informal caregiver. He was among a circle of people who fed, bathed and gave palliative care to his mother over a period of 10 weeks as she was dying from cancer.

“We had resources to draw on and great networks around us, and it was still at the limits of our ability,”

he says. “There are lots of people in our situation who have no resources, no networks, no experience and who deal with it a lot longer than 10 weeks.”

And that concerns Dr. Brown in his day job as assistant deputy minister for Health System Strategy in Ontario’s Ministry of Health and Long-Term Care. In that capacity, he has studied the indispensable role that family and friends play in looking after the elderly and those with disabilities.

One in five Ontarians is an informal caregiver, he says. While the formal healthcare system provides 25 per cent of care, informal caregivers provide the rest. “Although they’re largely unpaid, untrained, unregulated and often unthanked, informal caregivers are the largest workforce in our healthcare

system,” says Dr. Brown.

And this valuable resource is starting to disappear—just as the need escalates. Families are becoming smaller and

more geographically scattered. One-person households are more common. One-third of caregivers have children under 18, says Dr. Brown. One in six Ontarians reports that the demands of constant caregiving are

having a major impact on their ability to earn family income.

Meanwhile, another aspect of the demographic shift is that most caregivers are themselves growing older and may need care.

“Informal caregivers are probably the most threatened resource in the system,” observes Dr. Brown, also an assistant professor in the Department of Health Policy, Management and Evaluation at the University of Toronto.

Dr. Brown’s division, which establishes strategic directions and priorities for the province’s healthcare system, has studied this “classic, complex problem” by talking to informal caregivers, advocacy groups and others, with a goal of supporting this vital resource.

“Although they’re largely unpaid, untrained, unregulated and often unthanked, informal caregivers are the largest workforce in our healthcare system.”

— Dr. Adalsteinn Brown

Through long-range scenario planning, ideas are being developed to help caregivers and give them a voice. These range from defining caregivers’ roles and offering them training to providing them with protections and pensions.

The work of Toronto Rehab has been critical, Dr. Brown says, in developing technology-enabled systems and approaches that assist informal caregivers. “A lot of these things are making the opportunities for caregiving possible,” he says.

Canada can look to other countries for ideas. Japan, for example, has cooperatives in which older people look after each other, while Scandinavian countries offer limited support to informal caregiving.

Many of the ideas Dr. Brown’s division has identified are low-cost and low-risk, such as promoting volunteerism, enacting ‘good neighbour’ laws and encouraging employers to be sensitive to the responsibilities of employees who are also informal caregivers.

“Informal caregiving is critical to the sustainability of the healthcare system,” he says. “If we can’t count on it, we are in a remarkable world of difficulty.”



Dr. Adalsteinn Brown

Making headlines

You don't need to look far for news of Toronto Rehab research. It's making headlines, hitting air waves and popping up on news sites on the web. Some recent examples:

The Globe and Mail Sedentary workers at risk for sleep apnea



Sleep apnea is a potentially devastating sleep disorder in which the person actually stops breathing at least 15 to 20 times an hour. Obstructive sleep apnea is strongly associated with increased risk of serious conditions such as high blood pressure, stroke and heart attack. Until recently,

the cause of sleep apnea wasn't really known. It was thought to be linked mainly to obesity—yet 60 per cent of people with sleep apnea aren't obese. As *The Globe and Mail* reported, Dr. Douglas Bradley, a senior investigator at Toronto Rehab and director of the Sleep Research Laboratory, has identified a new cause: when people lie down at night, fluid that has accumulated in the legs during daytime moves into the neck and compresses the throat. This could be particularly true for people who are inactive during the day, such as those with desk jobs, because gravity forces fluid down to the bottom of the body during periods of inactivity. Dr. Bradley's breakthrough findings suggest it may be possible

to alleviate or even prevent sleep apnea by preventing fluid accumulation in the legs during the daytime. This could be done by using compression stockings or medications to reduce fluid levels, or by preventing fluid movement into the neck at night by elevating the head of the bed.

CBC News: Toronto Tracking hand hygiene

As CBC News reported, Toronto Rehab scientists have developed an easy-to-use electronic tool that healthcare facilities can use to help prevent the spread of potentially deadly hospital-acquired infections. Every year in Canada, about 8,000 patients die from infections they acquire while in hospital. Toronto Rehab's HandyAudit™ system helps hand hygiene auditors efficiently monitor and report hand hygiene compliance rates. The current paper-based observation system requires one auditor to simultaneously monitor the hand washing practices of four healthcare workers at once, and to record each of their hand washing actions. This can be a complicated task, and relies on subjective judgments. "The potential for error is high," says Dr. Geoff Fernie, one of the scientists who developed the new tool. With

PhD candidates Michael Tsang (left) and César Márquez Chin



HandyAudit, auditors can use touch screen technology to simply input actions into a personal digital assistant (PDA). Software analyzes these actions and calculates compliance rates.

The Toronto Star Rehabilitation team boosts quality of life

As part of a series on aging, journalist Judy Steed spotlighted some devices being developed at Toronto Rehab to help older people and those with disabilities live longer in their own homes. There's the 'Talking Bathroom', which guides people with dementia through the basic task of hand washing, and reduces the burden on caregivers. Then there's a new patient lift system designed to help professional and family caregivers safely move people, without hurting their own backs. The article also explains a proposal to replace 'curb cuts'—those ramps found at many street corners that slope down from the curb to the road. In bad weather, curb cuts can trap water, snow and ice, making it hard for people to get around. Toronto Rehab scientists have come up with an alternative: raise the road bed at the intersection to the level of the curb.



The Economist Computers that can see



This article in *The Economist* traces the development of computer-vision systems and their application in different areas, including advertising, product testing, crime prevention and road safety. The article also points to the use of computer-vision systems to help the elderly. It cites research at Toronto Rehab, where scientists are working on a system that employs computer-vision and artificial intelligence to detect if someone has fallen. Using a ceiling-mounted camera, the computer vision system tracks a person's movements in their home. The technology can interact with the person and determine who to call for help. Toronto Rehab scientist Dr. Alex Mihailidis, a leading expert in the use of computer vision and artificial intelligence in rehabilitation, directs the Toronto Rehab-University of Toronto research team. He holds the new Barbara G. Stymiest Chair in Rehabilitation Technology Research.

Citytv Exercise does heart patients good: study

The benefits of cardiac rehabilitation were highlighted in this report on Toronto's Citytv that focused on some major new findings. According to a 2009 study, people who participate in cardiac rehabilitation after experiencing a major heart event cut the



risk of dying from another one in half. The study, conducted by Dr. David Alter of the Institute for Clinical Evaluative Studies and Toronto Rehab, and Dr. Paul Oh, a Toronto Rehab scientist, compared the long-term survival rate of more than 4,000 people who had been hospitalized due to a heart event, such as a heart attack. Half of the study cohort completed a one-year cardiac rehab program while the other half did not. The participants who got cardiac rehabilitation received information and coaching about the changes they needed to make to live heart-healthier lifestyles. Consequently, they experienced a decreased mortality rate.

CBC News: The National Keeping an eye on Canada's older drivers



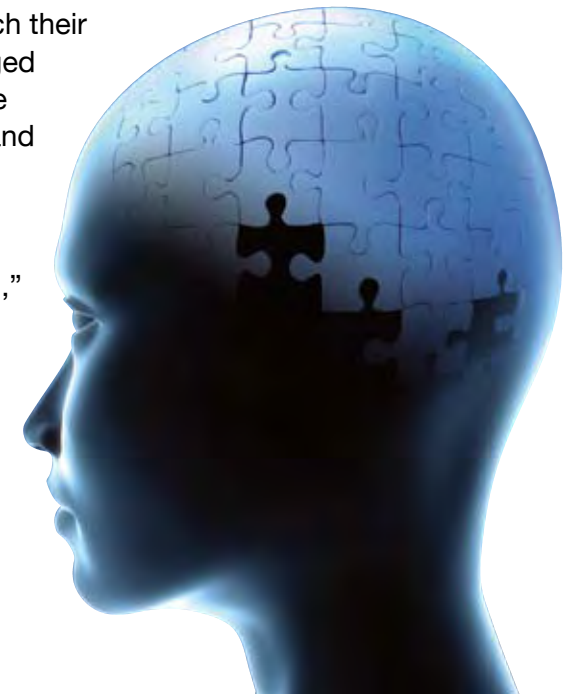
When is it time for older drivers to hang up their car keys? It's a difficult question not only

for drivers, but also for doctors who must evaluate patients' fitness to drive. As CBC News reported, a new study by Candrive (the Canadian Driving Research Initiative for Vehicular Safety in the Elderly) will follow 1,000 older adults for five years with the goal of identifying key factors that affect

the ability to drive safely. It will also aid in the development of a simple, objective assessment tool that family doctors can use to identify older drivers who are safe and unsafe to drive. "The population is aging and physicians are seeing more older drivers," Dr. Gary Naglie, a Toronto Rehab senior scientist and study co-investigator, told CBC. One of the main objectives of the study is to keep safe older drivers behind the wheel longer.

The Toronto Star After recovery, much is still lost

Dr. Robin Green, a Toronto Rehab scientist and neuropsychologist, sat down with *Toronto Star* columnist Diane Flacks to share insights into the challenges faced by brain injury survivors. Drawing on her research and clinical experience, Dr. Green described the often devastating symptoms that can continue long after the initial injury, including emotional changes, lack of motivation and an inability to read facial emotions, an area of study by Dr. Green. Her findings are leading to new therapeutic approaches for people experiencing psychological distress from brain injury, as well as strategies survivors can use to help family members and others understand the ways in which their injury has changed them. "The more people understand acquired brain injury, the better they will be at accommodating," Dr. Green told *The Star*.



Keeping you safe at home and at work

- + A high-tech safety net for the home
- + Driving after 70: staying safe on the roads
 - + Conquering the cold
- + Universal design: a world of possibilities
 - + Preventing brain injury on the job
- + Winter footwear: reducing slips and falls
 - + Great gadgets

Jennifer Boger (left), Justin Bimbrahw and Dr. Babak Taati (on ladder) are members of the team that developed a hands-free emergency response and fall detection system. It's designed to help older adults, like Sue Polanyi (centre), call for help. Here, Dr. Taati holds a ceiling-mounted unit that uses computer vision to detect if someone has fallen.



A high-tech safety net for the home



A wheelchair user since her stroke six years ago, Sue Polanyi lives an independent life. At 80, she travels, teaches piano, writes, and loves to entertain friends and family in her high-rise Toronto condominium overlooking the distant lake.

There are two-hour visits from caregivers five times a week and a personal emergency response system to summon help if she has trouble. But she finds the call button she's meant to wear on a pendant around her neck, "tiresome" and unnecessary given her proximity to the phone. So she tucks it away in a desk drawer in her spare bedroom.

That's where it was on New Year's Eve in 2007, when she slipped and fell on the marble floor in her bathroom. Her son-in-law found her there seven hours later, cold, dehydrated and embarrassed. She was rushed to hospital by ambulance.

Despite the scare and the pleadings of her children, Polanyi still doesn't carry the pendant. "It's so ugly," she says, "and I have my pride."

Such expressions of disdain for a device meant to provide peace-of-mind and enhance independence are common among older people, says Toronto Rehab scientist Dr. Alex Mihailidis, holder of the hospital's new Barbara G. Stymiest Chair in Rehabilitation Technology Research and an associate professor of occupational science and occupational therapy at the University of Toronto.

Many older people feel stigmatized by personal response systems, he says. "They just don't want to let anyone know—or even admit to themselves—that they have a disability." Others may have trouble pushing the button, or are concerned they will generate false alarms. Paradoxically, some older people worry that they will be removed from their homes and sent to institutions if they legitimately use the devices to call for help.

Now Dr. Mihailidis has developed a fall-detection device designed to allow older adults to live longer and more safely at home, while easing the concerns of family and friends. The system, which is ready to come to market, is among a range of 'intelligent' technologies he is working

on that use computer-vision and voice-recognition software and can be integrated into a home network. These include a smoke detector, a nutritional detection system, a burglar alarm and devices that 'coach' users about the steps in processes from handwashing and getting dressed to taking medication and preparing meals.

"We're trying to ensure independence, while taking the burden off the caregiver."

— Dr. Alex Mihailidis

"We're trying to ensure independence, while taking the burden off the caregiver," says Dr. Mihailidis, who started working on such devices as a graduate student in biomedical engineering, inspired by a colleague whose wife had early-onset Alzheimer's. He thought it would be useful to have a 'self-care' reminder system that would adapt to users' actions,



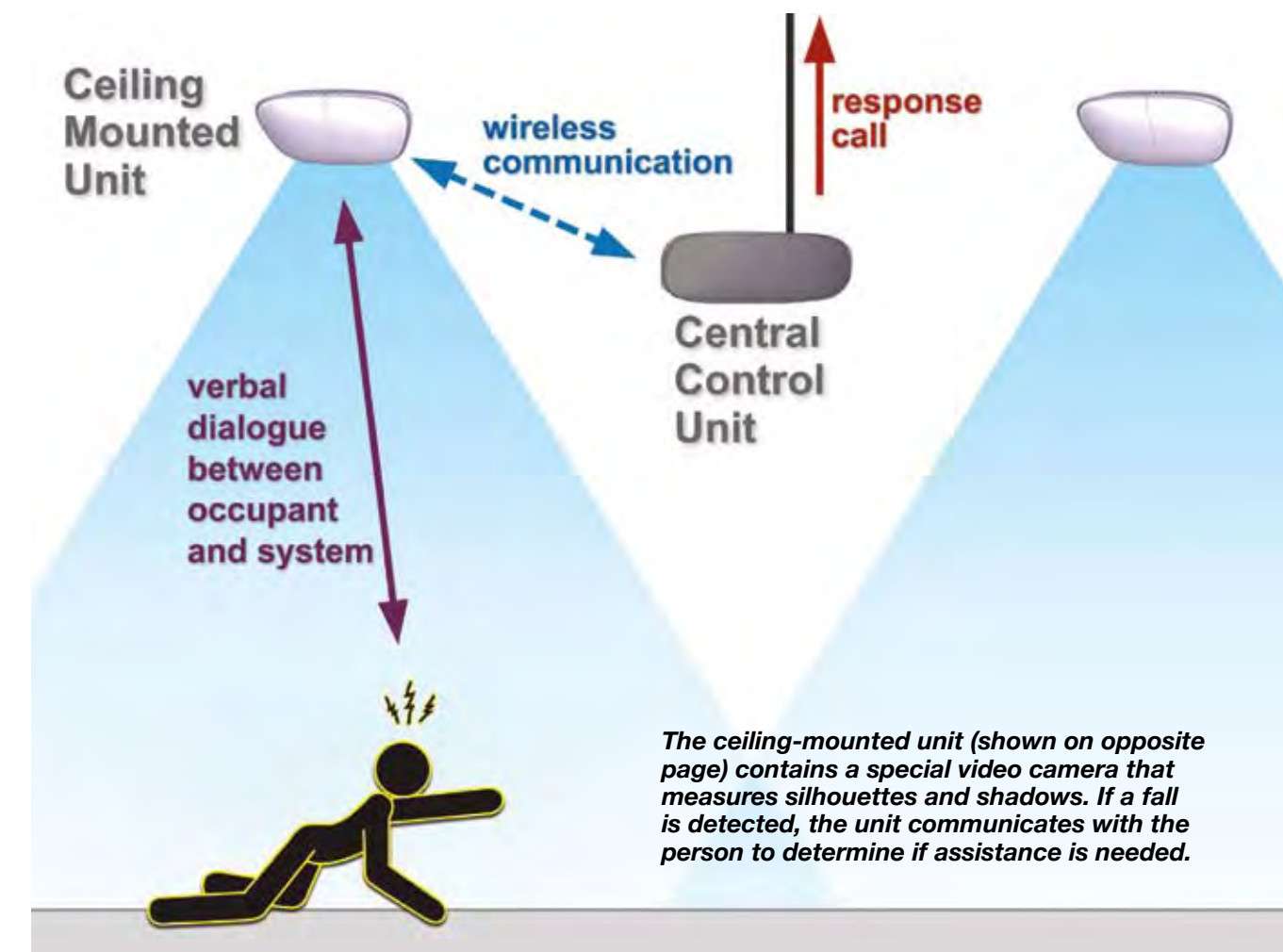
Dr. Alex Mihailidis

prompting them to perform tasks they neglect.

The fall-detection system, which Dr. Mihailidis calls 'The Helper', is now at the final stage of development and awaiting an industrial partner to commercialize it. At a cost of about \$100, it includes a simple camera mounted on the ceiling in the user's home that wirelessly relays images to a computer. It uses artificial intelligence to 'learn' and track the actions and patterns of the user. If the system senses that the user has fallen or stopped moving, it automatically calls out a series of questions with yes/no answers. If the person says that help is needed or no response is heard, the system can alert relatives or dial an emergency number.

Falls such as the one that happened to Sue Polanyi are the most common cause of injury for the elderly, Dr. Mihailidis says. One-third of older adults fall every year, he explains. About one-quarter of those people end up dying from complications as a result of their fall. "We believe we can really make a difference by improving safety in the home."

Future versions will be able to detect changes in a person's health and provide warning messages before things deteriorate. The team is currently working on a new feature that will monitor what a person is eating and drinking—and how often. It will provide a verbal prompt if, for example, the person doesn't eat fruits and vegetables or forgets to drink fluids.



Driving after 70

staying safe on the roads

At 80, Margaret Granger loves her car—a burgundy coloured Porsche which “always goes faster than it should.” She also depends on her car.

“I use it every day,” says the retired teacher, who plays badminton daily and also drives to ballroom dancing, bingo and lunch with friends. “It would be difficult for me to do the things I like to do without a car.”

Granger hopes to keep driving for a long time. She thinks she’ll know when it’s time to hang up the keys. But she wishes there was a simple way to assess older drivers’ abilities.

That’s why Granger signed up to participate in an unprecedented study of older drivers. The new study by Candrive (the Canadian Driving Research Initiative for Vehicular Safety in the Elderly) will follow 1,000 older adults for five years with the goal of identifying key factors that affect their ability to drive safely. It will also aid in the development of a simple, objective test that family doctors can use to identify older drivers who are safe and unsafe to drive.

As Canada’s population ages, the number of older people who hold a driver’s license is growing steadily. Most are perfectly safe

drivers—but some are not. Statistics show that both new drivers and elderly drivers are most at risk for motor-vehicle crashes per kilometre driven, with an almost exponential increase after the age of 75. Yet other studies show that some of the safest drivers are senior drivers.

“The issue is not age, but a question of functional ability,” says Toronto Rehab geriatrician and senior scientist Dr. Gary Naglie, one of the study investigators. Toronto Rehab is headquarters for the Toronto portion of the study. “We need to have a better understanding of the extent to which medical conditions and medications impair physical and/or cognitive functioning that can affect older people’s ability to drive.”

Dr. Naglie’s previous research has shown that many family doctors do not feel confident in their ability to evaluate patients’ fitness to drive. In a survey of 460 family physicians across Canada, more than 80 per cent of respondents said driving assessment is an important issue in their practice, yet over 40 per cent did not feel confident in their ability to evaluate patients’ fitness to drive. In most provinces, physicians are legally obligated to report drivers who they believe may be unsafe behind the wheel. When a physician reports concerns to licensing authorities, it often means the person will have their license revoked, Dr. Naglie says.

“We need a simple, objective screening tool that will assist physicians to identify safe and unsafe older drivers in their offices without needing any special equipment,” says Dr. Naglie.

The need for such a screening tool

will only become more urgent. By about 2025, one in four drivers will be 65 or older. Estimates are that by 2028, there will be about 98,000 drivers with dementia in Ontario alone.

A screening tool would help to identify older drivers who are safe to keep driving, says Dr. Naglie. Currently, because of lack of confidence, some seniors elect to stop driving prematurely—even though they are still safe to continue, he says.

For her part, Margaret Granger says she’s always been a cautious driver but “I’m probably more cautious now. It’s hard to say.”

She has noticed some changes in her driving over the years. “I’m more anxious when I drive late at night, especially on Highway 401, because those transports come by and they’re overwhelming. That never used to bother me. It does now.”

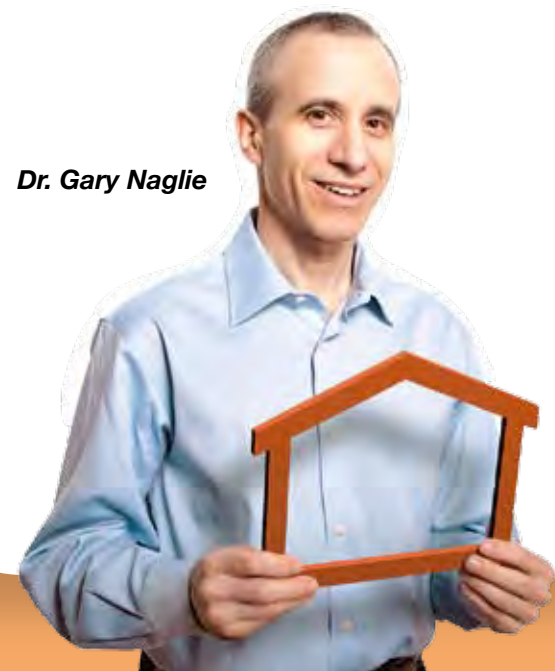
Adds Granger: “I think about my age, and I think, ‘You’re maybe not as quick as you used to be, so you better take it easy.’” But she doesn’t know for sure—nor does her doctor. Which is why the driving study is “very worthwhile”.

Taking place in seven Canadian cities and also in Australia, the study includes questions about driving habits and behaviours, medical symptoms and medications, physical assessments, and collection of data on crashes and traffic violations.

Dr. Naglie is co-leader of the Toronto portion of the study with Dr. Mark Rapoport of Sunnybrook Health Sciences Centre. Both are members of Candrive, an interdisciplinary health-related research program that aims to improve the health, safety and quality of life of Canada’s older drivers. Candrive is funded by the Canadian Institutes of Health Research.

For information on how to participate in the driving study in Toronto, please call Novlette Fraser at 416-597-3422, ext. 7851. Participants must be 70 or older and drive at least four times a week.

By about 2025, one in four drivers will be 65 or older.



Dr. Gary Naglie



Driving study participant Margaret Granger: “It would be difficult for me to do the things I like to do without a car.”

Conquering the cold

Dr. Yue Li spends her days at Toronto Rehab thinking about something she doesn't like—winter. Growing up in China with plenty of cold and snow, she didn't catch a break with the climate when she moved to Canada to pursue postdoctoral studies.

Ironically, Dr. Li developed a passion for research that helps older people, those with disabilities and other individuals to better cope with the challenges of winter.

"I think about my parents and grandparents and how my research could help them," says the biomedical engineer and leader of Toronto Rehab's Winter Research Group. "The problems of winter are not only ice and snow, but also how our bodies react to the cold and the impact it has on people who are already at risk."

It's an important area of study because deaths in winter increase by as much as 60 per cent mainly due to heart attack and stroke. Recent findings from a Winter Research Group project shed light on what might be one underlying cause of this staggering statistic.



Dr. Yue Li

"We wanted to know if there is a direct link between not wearing a hat when it's cold out and elevated blood pressure, because stroke and heart attacks are closely related to your blood pressure," says Dr. Li.

The Winter Research Group discovered that when people were exposed to cold while wearing outdoor winter clothing but no hat, their blood pressure surged—a risky situation, especially for seniors and individuals with hypertension and cardiovascular disease. On the other hand, wearing a hat not only reduced the blood pressure response

during exposure to cold but it also promoted faster recovery of forehead skin temperature and blood pressure.

The Toronto Rehab study was conducted in the hospital's cardiopulmonary laboratory, where a temperature-controlled room can create different environments—from heat and humidity to cold and ice. Findings from the first phase of the study were published in the December 2009 issue of the *European Journal of Applied Physiology*.

Although scientists around the world have done considerable research on the effects of cold and winter, they have mainly focused on industry and the military. Toronto Rehab's Winter Research Group is among the first to examine how cold exposure and winter conditions affect the public, including older people and those with disabilities.

"The significance of winter has been underestimated. The reality of people's lives is that they have to cope with cold weather, snow drifts, puddles, uneven ground, icy steps, ramps and more," says Dr. Geoff Fernie, vice president, research, at Toronto

Rehab. "So a big focus for us is to get out and get real, to try and deal with these challenging situations—and winter is a big one."

A survey on winter accessibility conducted by Dr. Li's team found that fewer middle-aged people venture outdoors when snow and ice are combined with cold—and the number of people ages 60 to 85 who go out drops by almost half. The main conditions identified for decreasing pedestrian winter accessibility were icy sidewalks and puddles at curb ramps.

Many other practical and innovative projects are underway within the Winter Research Group. Examples include: developing footwear that is safer for walking on snow and on ice; designing winter coats that are warmer and easier to put on and take off; and exploring the potential benefits of a fabric-style face mask with hidden copper coils that warm cold air to room temperature before the wearer breathes in.

Dr. Paul Oh, a scientist and medical director of Toronto Rehab's Cardiac Rehabilitation and Secondary Prevention Program, also plans to study the effects of physical activity in cold weather. "Why do people die when snow shovelling and how do you exercise safely in the winter?"

The Winter Research Group will develop an evidence-based guideline to provide information and advice for the public to apply during specific winter conditions. It's hoped that this tool will decrease isolation and improve people's ability to participate in community life. The guideline will aim to reduce deaths, injury and illness from cold exposure and other challenges of the winter season.



When people are exposed to cold while wearing outdoor winter clothing but no hat, their blood pressure surges.

Universal design

a world of possibilities



Universal design makes this kitchen work for everybody—not only the able-bodied majority. The kitchen was designed by U.S. architect Jane Langmuir.

Easy to access, easy to use: the ultimate in common sense and livability. That's what universal design is all about and it applies to everything created for the urban environment—from a cell phone to a house, and from an ice cream scoop to a pedestrian street crossing. Universal design opens up a world of possibilities by making products, homes and communities safe and user-friendly for all people, including seniors and those with disabilities.

It's what Dr. Geoff Fernie, Toronto Rehab's vice president, research, describes as "having a morality of design, a sense that we want to support the development of products and environments that are good for everyone in our society. And there's plenty of evidence that when universal design principles are incorporated from the beginning, it doesn't increase the cost."

Toronto Rehab has partnered with U.S. researchers to turn universal design into a reality, making it easier for people to do

everything from pulling on winter boots to finding their way in unfamiliar buildings. Universal design can make life easier for a parent pushing a child in a stroller and for individuals with mobility, visual, hearing or cognitive challenges.

"Our hope is that people with special needs will have many of their needs met by universal design and that they will require fewer elements of special technology," says Dr. Fernie. "If you have a building that allows someone with arthritis or a person using a wheelchair to move around safely and independently, then you don't have to make special arrangements. The building meets their needs the same way it meets the needs of an able-bodied person."

Universal design promotes mobility—inside and outside—whether a person is on foot or uses a scooter, wheelchair or walker. Toronto Rehab researchers are looking at ways to improve the out-of-doors pedestrian environment—with special attention to the challenges of winter—while also exploring how to enhance accessibility inside homes and buildings.

Guidelines are being developed to help people adapt their homes so they can continue to live there safely as they grow older. While some homes will need more significant renovations to accommodate aging in place, others may just require the installation of assistive technology. Examples include safety poles and devices that help with lifting, bathing and toileting. Dr. Fernie hopes that in the future, new homes will be built in a way that supports older people and their caregivers.

A recent study on scooter accessibility is helping to set a new design standard for use with the Accessibility for Ontarians with Disabilities Act. The act requires that the Ontario environment be fully accessible by the year 2025. With an increased number of larger scooters being used by an aging population, the turning radius mandated for wheelchairs in buildings such as hospitals and hotels is insufficient to accommodate scooters. By testing a range of scooters using a three-point turn, "we have designed a rectangular space that is a much more practical standard than the circle," says Dr. Fernie.

In the outside environment, Toronto Rehab scientists have designed a barrier-free pedestrian crossing as an alternative to

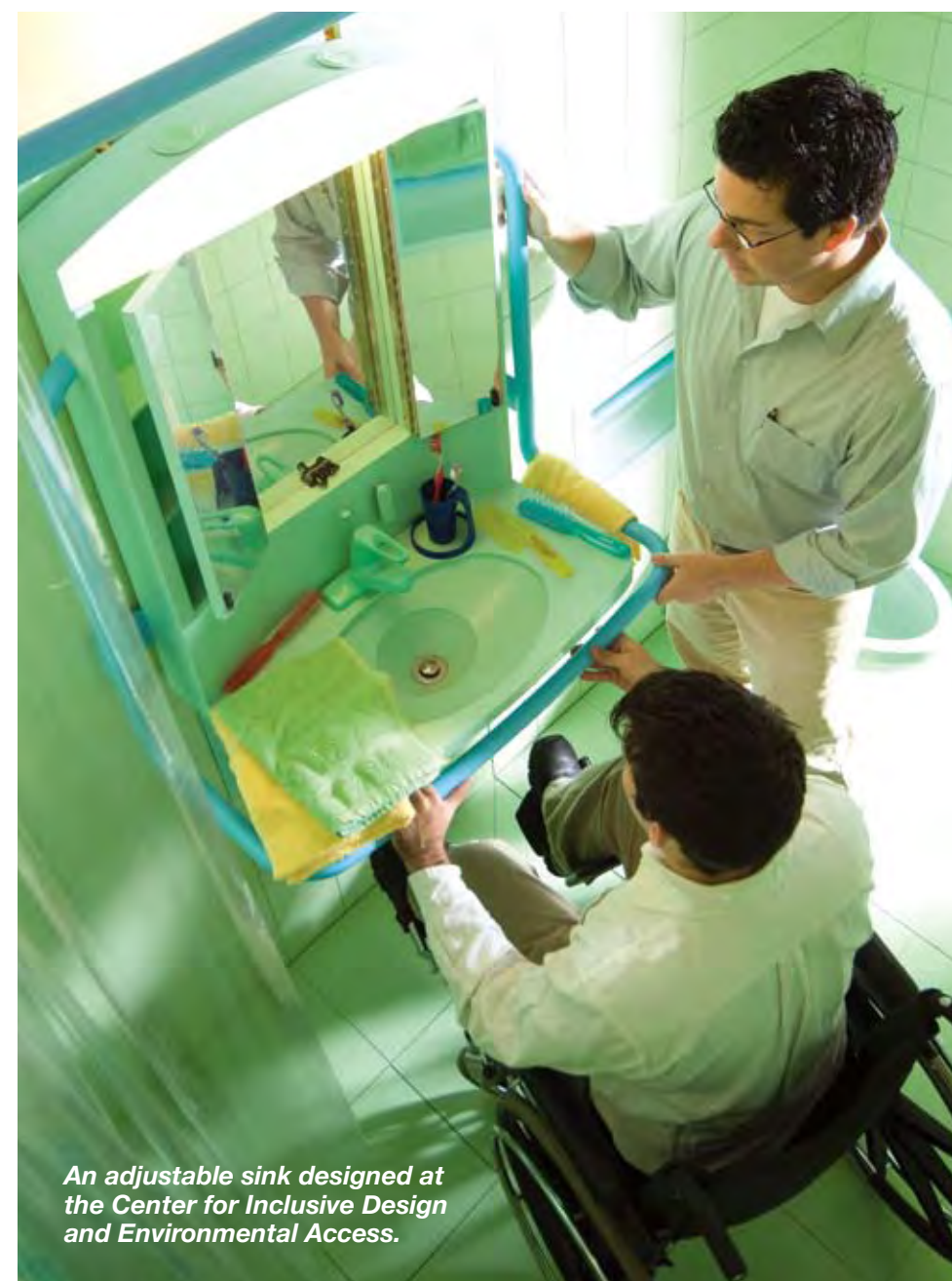
"As the population ages, the market moves and that's the biggest driving force behind universal design."

— Dr. Geoff Fernie

curb cuts that trap water, ice and snow in the winter. Plans call for testing of this new design in the cities of Toronto and Kingston. By attaching wireless instruments to study subjects, investigators are also gaining insights into how outside temperature affects walking speed, which in turn can help city planners to better time the lights at pedestrian crossings.

Other studies address the challenges posed by stairs and ramps. While most ramps are designed to accommodate wheelchair use, many are difficult to negotiate for people with arthritis in their knees and ankles, or those who have had knee replacement surgery.

"As the population ages, the market moves and that's the biggest driving force behind universal design," says Dr. Fernie. "By continuing to come up with scientifically-based principles that enable us to achieve real universal design, we have the opportunity to truly change people's lives for the better."



An adjustable sink designed at the Center for Inclusive Design and Environmental Access.

Dr. Edward Steinfeld: a man of IDEAs

Four years into a vibrant research partnership in universal design between his U.S. team and the Ontario Rehabilitation Technology Consortium, headquartered at Toronto Rehab, architect Dr. Edward Steinfeld is effusive.

"We have developed a capability with our collaboration that is unequalled anywhere in the world," says Dr. Steinfeld, an acknowledged founding father of universal design and director of the Center for Inclusive Design and Environmental Access (IDEA Center) at the University at Buffalo: The State University of New York.

"We have an incredibly diverse group of researchers and people experienced in the environmental design field and product design. I think we have a team and resources that can't be found anywhere else."

It's an exciting development for someone whose interest in barrier-free design was stirred by injured Korean War veterans "who couldn't be independent because nothing outside of their rehab center was accessible." Family members' work in the construction trades had sparked his interest in the study of architecture, and he became one of the first Americans to earn a doctorate in this specialty. In the years to follow, Dr. Steinfeld helped create new standards for accessibility, pioneered research in barrier-free architecture and founded the IDEA Center. Now he is delighted to partner with like-minded researchers at Toronto Rehab.

The partnership is co-directed by Dr. Steinfeld and Toronto Rehab's Dr. Geoff Fernie and funded by the U.S. National Institute on Disability and Rehabilitation Research. Diverse studies on universal design include understanding the issues of cold weather environments, and helping people with early dementia remain independent and functioning safely in their homes, to the creation of a usability rating scale for consumers, designers and researchers to evaluate household and home office products such as appliances and computer software.

Another exciting development has been the advancement of a concept called 'visitability' housing in the U.S. and Europe—something both Drs. Steinfeld and Fernie hope will take root in Canada as well. Visitability is a standard designed to ensure that all new homes have at least one no-step entrance. It also includes access to at least a half-bathroom, food preparation facilities and a major living space on that same entry level.

In the future, Dr. Steinfeld would like to see "many accessible choices in different types of housing—publicly supported, privately financed, multi-family and single-family housing."

For people planning to remain in their current homes as they get older, he recommends "a renovation to create a no-step entry or creation of one with a ramp, a full bathroom and a space on the entry level that could be used as a bedroom if necessary."



Dr. Edward Steinfeld

Preventing brain injury on the job

August may be the cruellest month for brain injuries in Ontario's construction industry, but a new study shows October is not far behind.

"We thought it was important to track these injuries month by month," says Dr. Angela Colantonio, a senior scientist at Toronto Rehab and co-author of the study published in the journal *Brain Injury* in 2009.

Few academic studies have looked at brain injury among construction workers. Yet the construction industry—with approximately 400,000 workers in Ontario alone—is known to have a high rate of serious brain injury.

Traumatic brain injury (TBI) is a leading cause of death and disability. TBI can profoundly affect a person's cognitive skills, memory, language and behaviour, as well as their independence, work life, and ability to participate fully in the community.

The authors weren't surprised to find the highest number of brain injuries in the busy construction month of August, while December had the lowest number. But they didn't expect to find a second peak of injuries in October. This may reflect a surge in work to complete projects prior to the winter months. Contributing factors, they speculate, could

be shorter days to work, less light, and more adverse weather conditions. The authors want to do further study to find out if this seasonal pattern holds for other years.

Their study also begins to raise questions about the time of day when many construction-related brain injuries occur. It identifies two peaks during the day: the hour before and the hours after lunch.

"Most of us know that lethargic feeling that hits just before or after lunch at work: our energy dips, it's hard to focus but we have a job to finish," says Dr. Colantonio. Other factors may also be distracting workers in anticipation of, or during, their lunch break—and affecting their attention on the job. "For construction workers, this could have devastating consequences."

Among other findings, younger workers were much more likely to experience brain injuries in the morning, while older workers were more likely to suffer such injuries in late afternoon. "More injuries in the morning for younger workers can potentially be explained by shifting sleep cycles in young adults favouring later times to go to sleep and get up, as well as overall shorter hours of sleep," the authors suggest.

Fatigue may also be contributing to injuries experienced by older workers in the afternoon. Falls were much more likely to be the cause of injury among older workers.

"These results provide valuable information for preventing these injuries," says Dr. Colantonio. "They can be incorporated into prevention strategies."

Doug McVittie, assistant general manager and director of operations for the Construction Safety Association of Ontario (CSAO), says his group will circulate the findings to construction companies across the province, as well as labour and management health and safety committees. The results will also be shared with CSAO staff members who provide training and safety seminars for construction workers.

"Construction workers work in circumstances which are in some cases inherently risky; we're working at heights, we've got temporary and incomplete structures,

moving equipment, moving materials," says McVittie, a study co-author. "Our association is interested in working to enhance the understanding of construction risks, and help with getting a better appreciation for the prevention message out there in all sectors."

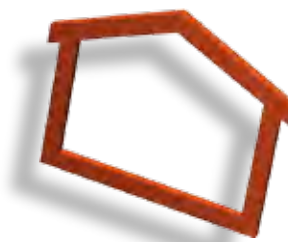
Says Dr. Colantonio: "Our findings have drawn attention to areas that, with more study, could actually expose some of the underlying causes of work-related brain injury."

The study used data from the Ontario Workplace Safety and Insurance Board on 218 cases of non-fatal brain injury which resulted in days off work in 2004-2005.

Dr. Colantonio holds the Saunderson Family Chair in Acquired Brain Injury Research at Toronto Rehab. She is also a professor in the Department of Occupational Science and Occupational Therapy at the University of Toronto.

"Most of us know that lethargic feeling that hits just before or after lunch at work... For construction workers, this could have devastating consequences."

— Dr. Angela Colantonio



Dr. Angela Colantonio

Winter footwear reducing slips and falls

Walking in winter conditions can be downright dangerous. In 2004-2005, more than 21,000 Ontarians visited an emergency room because of injuries

"In the long term, we want to determine winter footwear designs best suited for protecting everyone."

— Jennifer Hsu

related to a fall on ice or snow. Postal workers are particularly at risk because they work outdoors in all types of weather on a wide variety of surfaces. Helping postal workers—and ultimately everyone who spends time outdoors—to walk safely across a variety of winter surfaces is the challenge facing Jennifer Hsu, a member of Toronto Rehab's Technology Team and a PhD candidate in biomedical and mechanical engineering at the University of Toronto.

With financial support from Ontario's Workplace Safety and Insurance Board (WSIB) and the collaboration of Canada Post and the Canadian Union of Postal Workers, Hsu and others at Toronto Rehab are especially interested in how footwear functions on inclines and across different surfaces.

Boots that are designed specifically to work on ice and snow are one thing, but many people—including postal workers—routinely walk across a range of different surfaces such as concrete, ceramic tiles, ice and snow. "People who have to make these transitions don't have good footwear choices," says Hsu. "For instance,

crampons work well on ice, but can be useless on hard, bare surfaces."

Hsu will interview postal workers to learn about their experience with slips and falls, their preferences in footwear and the conditions they experience.

"Then, we'll actually 'field test' different footwear by recording and analyzing how subjects walk on transitions between ice and concrete and down icy ramps," she says.

Using a special lab that simulates winter conditions, researchers will begin by testing four types of winter footwear: a regular boot, footwear with steel-studded ice cleats, devices with steel coils on the sole that slip on over regular boots, and traction footwear with a sandpaper-like sole.

"There's little understanding of the performance of winter footwear on transitions between slippery and non-slippery surfaces and down sloped surfaces," Hsu says.

Study results will be used to make recommendations on effective forms of protective footwear against slips and falls on inclines and transitions, as well as to develop improved winter footwear design criteria.

"We're starting with a young healthy population," Hsu adds. "In the long term, however, we want to determine winter footwear designs best suited for protecting everyone."



Jennifer Hsu

Great gadgets

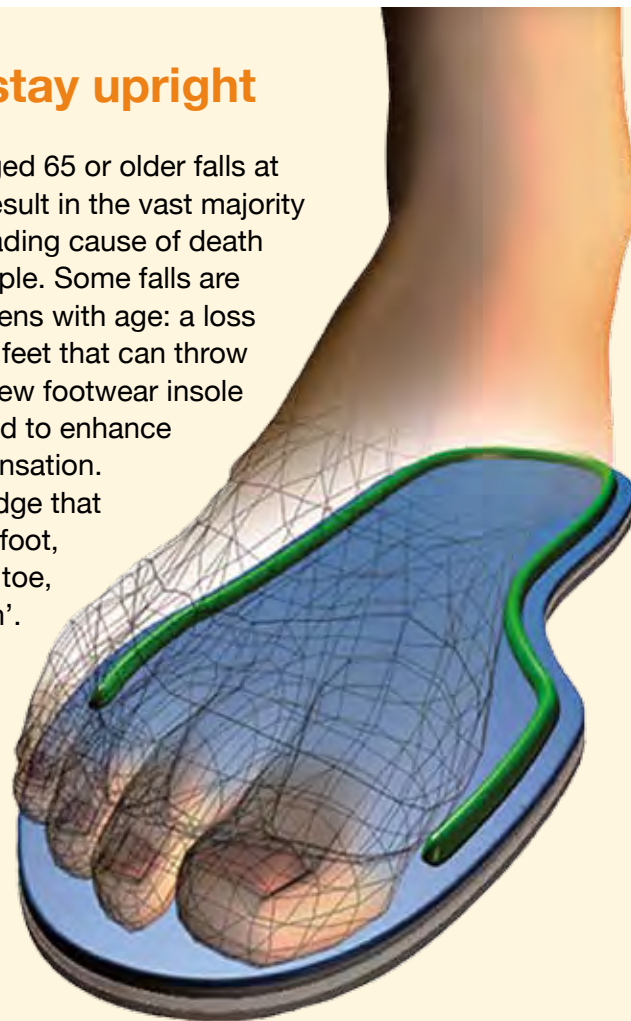
Innovations to help you stay at home and in the community

Special insole to stay upright

Roughly one in three people aged 65 or older falls at least once a year. These falls result in the vast majority of hip fractures, which are a leading cause of death and disability among older people. Some falls are related to something that happens with age: a loss of sensation in the soles of the feet that can throw people off balance. A special new footwear insole called SoleSensor™ is designed to enhance balance by heightening sole sensation. The SoleSensor has a raised ridge that surrounds the perimeter of the foot, stopping just short of the large toe, to increase 'sensory perception'.

"If you're swaying back and forth, the raised edge will apply pressure to the side of your foot, telling you subconsciously that you're falling so that you can adjust your body movements," says Dr. Stephen Perry, a Toronto Rehab adjunct scientist based at Wilfrid Laurier University.

Published research shows that older adults who wore the SoleSensor in winter had half the number of falls. Now on the market, the SoleSensor grew out of Dr. Perry's PhD thesis. Co-inventors are Dr. Brian Maki of Sunnybrook Health Sciences Centre, and Toronto Rehab senior scientists Drs. William McIlroy and Geoff Fernie.



'Way-finding' belt

Losing one's way is a common problem for people with visual impairments and those with Alzheimer's and other forms of dementia. Daily activities can be frustrating, and many people withdraw and become increasingly housebound. Scientists at Toronto Rehab are testing a new device to help these people find their way around. It's a unique 'way-finding' belt that uses a combination of GPS, Bluetooth and gentle vibration cues to direct the wearer to their destination. The belt is worn around the person's waist and gently vibrates against their stomach, back, and left and right sides to indicate which way they should go.

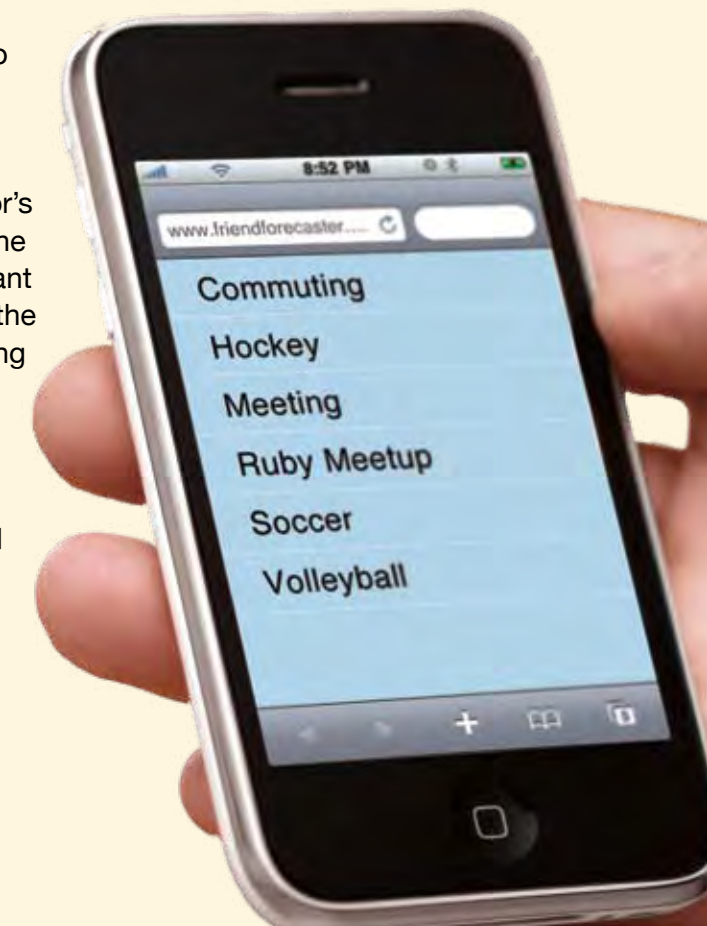
"We want to help people stay independent for as long as possible," says Lawrence Grierson, a postdoctoral fellow and member of the Toronto Rehab, University of Waterloo and University of Toronto team now testing the way-finding belt with funding from the Alzheimer's Association. "We also hope the belt will ease the worry experienced by many caregivers."



Names on demand

Most of us have experienced that embarrassing moment when we are at a friend's house and cannot remember their children's names, or at the doctor's office racking our brains for the receptionist's name. Research shows that forgetting names is one of the biggest concerns for older people who are starting to lose their memory. So imagine a device that knows where you are and can prompt you with the information you need, right away. That's the idea behind new software called Friend Forecaster developed by researchers at the University of Toronto, Sunnybrook Health Sciences Centre and Toronto Rehab.

"The software we're working on can be downloaded to a cell phone to cue people in everyday situations," says Kent Fenwick, who worked on Friend Forecaster as part of his master's thesis under the direction of Dr. Ron Baecker, a University of Toronto computer science professor and Toronto Rehab adjunct scientist. "For instance, if the person goes to the doctor, Friend Forecaster uses GPS to establish their location and then provides information such as the doctor's name, the assistant's name, the number of children the assistant has, and topics discussed at the last appointment." With funding from Bell University Labs and the federal government, the team has carried out promising early testing of Friend Forecaster that has led the design of more general location-aware augmented communication aids.



Keeping you out of hospital

- + Detecting sleep apnea: a simple in-home solution
 - + Prescription for a healthy heart
- + The exercise challenge: making the most of second chances
 - + Dealing with diabetes at home and on the road
 - + Great gadgets

Toronto Rehab scientists are working to keep those who have a disability or disease out of hospital. Sometimes, this means detecting a condition so it doesn't lead to serious complications. Dr. Hisham Alshaer is developing a device that can be used in the home to detect obstructive sleep apnea (see Detecting sleep apnea: a simple in-home solution on page 24).



Detecting sleep apnea a simple in-home solution

This lightweight sleep apnea detection device consists of an open mask with a small microphone that can accurately sense the sounds of breathing.



Obstructive sleep apnea is linked to a range of serious problems from accidents caused by daytime drowsiness to increased risk of cardiovascular disease—yet only a fraction of cases are ever diagnosed or treated.

The disorder, in which the throat

collapses during sleep causing people to stop breathing repeatedly for short periods while sleeping, affects an estimated 10 per cent of Canadians. Detecting it can be a time-consuming and costly business.

“People usually get referred to sleep labs or sleep specialists because of suspected sleep apnea related to a history of snoring,” explains Dr. Douglas Bradley, a senior scientist at Toronto Rehab and director of the hospital’s Sleep Research Laboratory. “But sleep labs are expensive to operate and often have long waiting lists. Also, because they tend to be located in urban centres, they are hard for some people to get to.”

So Dr. Bradley and his team decided to devise an easier, more convenient way to diagnose obstructive sleep apnea. And it’s already taking shape in their lab—an inexpensive portable monitor for at-home use. The device can diagnose sleep apnea from the breathing sounds a person makes while sleeping.

“Basically, it’s a microphone in a modified face mask,” says Dr. Bradley. “It records breathing sounds during sleep. These sounds are analyzed by a computer programmed to detect volume, frequency and fluctuations in sound. From this, we can tell if apnea occurs.”

Dr. Hisham Alshaer, a PhD candidate in biomedical engineering at the University of Toronto, has spearheaded the development of the portable monitor. He says results

obtained with the monitor closely match those obtained with polysomnography—the conventional and highly-reliable method used by sleep labs to detect sleep apnea.

“When our device becomes available, people will no longer face long waits or the inconvenience and discomfort of testing at a sleep lab,” he says. “They will simply be provided the device, go to sleep at home wearing the device and have their breath sounds analyzed automatically to obtain their diagnosis.”

As a next step, the team will test their device on a larger group of patients. Patent applications have been filed and the scientists are working with several companies to develop a more advanced prototype. “Our long-term goal is to bring the monitor to market and make it widely accessible,” says Dr. Bradley.

Sleep apnea is treatable with continuous positive airway pressure (CPAP), a device which applies air pressure through a mask worn over the

nose at night. The air pressure prevents the throat from collapsing and eliminates apneas.

If not diagnosed and treated, obstructive sleep apnea can have devastating consequences, even in otherwise healthy people. Studies by Dr. Bradley and others have shown that the disorder is strongly linked to high blood pressure and increased risk of stroke and heart failure.

“When our device becomes available, people will no longer face long waits or the inconvenience and discomfort of testing at a sleep lab.”

– Dr. Hisham Alshaer

Prescription for a healthy heart

Dr. David Alter has good news and bad news.

The Toronto Rehab scientist has proven that cardiac rehabilitation saves lives. What distresses him is that only 20 to 30 per cent of heart patients are using cardiac rehabilitation programs. He is looking at how to deliver such programs to a vast—and growing—population of people who need them.

“We need to think outside-the-box, to find ways for people with cardiovascular conditions to stay healthy at home and out of hospital,” says Dr.

Alter, a cardiologist and research director of Toronto Rehab’s Cardiac Rehabilitation and Secondary Prevention Program, as well as a senior scientist at the Institute for Clinical Evaluative Sciences (ICES) and associate professor at the University of Toronto. He increasingly thinks the answer is home-based, “self-management” of cardiac rehabilitation. “We need to administer these programs to larger populations so they work.”

Dr. Alter’s groundbreaking study, conducted with Toronto Rehab scientist

Dr. Paul Oh and published last year in the *European Journal of Cardiovascular Prevention and Rehabilitation*, followed 4,084 people who had been hospitalized for cardiac events between 1999 and 2003. Half of the patients underwent cardiac rehabilitation, including exercise, dietary counselling, weight reduction, stress counselling and other lifestyle modifications, while the others did not.

Those who participated in rehabilitation cut their risk of dying of another heart attack in half.

Considering such evidence that it works, participation rates in cardiac rehabilitation are

surprisingly low. Barriers range from the institutional to the personal, says Dr. Alter. For example, the medical community is more accustomed to treating heart problems with stents and medication than lifestyle approaches. Some patients, whom he calls “deniers”, resist reforming their ways, while others find it difficult to get to rehabilitation programs in the first place. And, he adds, the healthcare system is geared and financed toward treating medical emergencies rather than promoting heart-healthy behaviours.

Addressing all of these factors is a big job, Dr. Alter says.

For physicians like him, understanding and “buying into” the recent literature on the benefits of behavioural modification requires “a new mindset,” he says, “less of a traditional, ‘take-your-pill’ attitude.”

For patients, he favours tailoring rehabilitation to the individual. This should begin with an extensive medical assessment and personal interaction, but can then go on



to being administered at home. For many, he says, everything from attendance at educational programs to the monitoring of heart rates can happen by computer.

Finding flexible ways to reach and engage people is key. Dr. Alter, a singer-songwriter with his own music label, Vigour Records, aimed at bridging music and health, believes that new areas such as music therapy may be helpful in changing behaviours. He says music can elicit positive emotional responses among depressed patients and improve exercise tolerance.

“‘Art and healthcare’ is an emerging scientific discipline with many proven, cost-effective applications,” he explains. “We need to begin to better examine whether such humanistic approaches have a role to play in cardiac rehabilitation and other vascular risk-reduction programs.”

For the overall healthcare system, dealing with the prevention of and rehabilitation after heart problems is a critical yet monumental task, he says. According to a February 2009 report of the Canadian Heart Health Strategy Action Plan, nine in ten Canadians have at least one risk factor for heart disease or stroke, including smoking, alcohol, physical inactivity, obesity, high blood pressure, high blood cholesterol and diabetes.

“There’s still a long way to go,” Dr. Alter says, adding that the goal is to empower people to care for themselves and especially become more active. “At the end of the day we will save lives.”

Dr. David Alter



The exercise challenge

Making the most of second chances



When a person is diagnosed with a condition such as diabetes or is recovering from a heart attack or stroke, regular exercise should become their new best friend. It provides one of the greatest opportunities to extend lifespan and improve quality of life by lowering the risk of recurrence and secondary complications. Plus, exercise is one of the best-known stress busters.

But how do people know which exercise regimen is appropriate and safe? Should they work out at home or in group settings? Toronto Rehab researchers are probing these and other questions as they develop community exercise programs designed to help people continue their recovery, improve fitness levels and stay out of hospital.

Stroke and exercise

Although research shows that the average person should walk 10,000 steps a day, after a stroke most people walk about 2,800 steps daily or the equivalent of a mile. Regular exercise is an important part of recovery after stroke and it also helps lower the risk of having another stroke. Without sufficient exercise and community involvement, people can become isolated, depressed, their health deteriorates and the 'road to recovery' becomes the path back to the hospital. Getting on With the Rest of Your Life, a national research project funded by the Canadian Stroke Network, helps stroke survivors get active and reintegrate into community life. Exercise, along with social, leisure and learning opportunities are the key elements of the program, which involves 72 two-hour sessions over the course of a year. Toronto Rehab is overseeing the clinical component. Scientist Dr. Mark Bayley, a member of the research team, says early results are promising. "People are becoming more active and involved in their communities when they participate in this program."

Cardiac conditions and exercise

People who participate in cardiac rehabilitation after a major heart event cut the risk of dying from a subsequent heart event in half. Despite this fact, work, transportation and family obligations can be barriers to participation (see *Prescription for a healthy heart* on page 25). That's why Toronto Rehab scientist Dr. Paul Oh and his team came up with the idea of a home-based cardiac rehab program. It includes an assessment and a personalized exercise plan, working out at home, emailing exercise logs, and a weekly half-hour phone check-in and educational session with a case manager. Results are on par with the hospital's onsite outpatient cardiac rehab program: a 20 per cent improvement in functional capacity of the heart and lungs and a high level of participant satisfaction.

Acquired brain injury, multiple sclerosis and stroke and exercise

An exercise program for people with stroke, acquired brain injury and multiple sclerosis has been so successful that Toronto Rehab staff are creating a tool kit to help other health professionals use it. Together in Movement & Exercise (TIME), an evidence-based community fitness and wellness program created in partnership with Toronto Parks, Forestry and Recreation and operating in two community centres, picks up where the formal healthcare system leaves off. "It is very difficult for these people to participate in standard forms of exercise and it takes the expertise of a clinician to develop a program that is really doable," says Jo-Anne Howe, clinical educator in physiotherapy at Toronto Rehab. Using a circuit training format, city fitness instructors lead the exercise classes twice a week for people who can independently walk a minimum of 10 metres with or without walking aids.

Acute myeloid leukemia and exercise

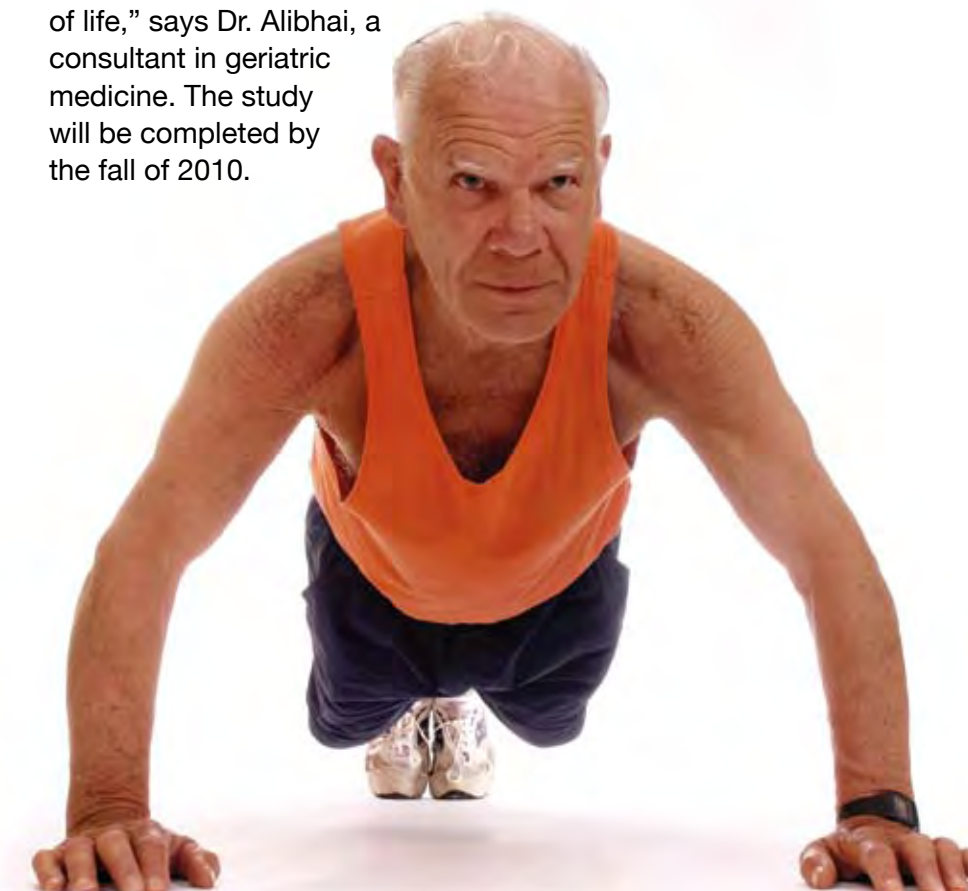
People who have completed treatment for acute myeloid leukemia often experience fatigue, especially those over the age of 50. Toronto Rehab scientist Dr. Shabbir Alibhai has developed a 12-week home-based exercise program for these individuals. Early results from a pilot study show "improvements in fatigue levels, physical and emotional functioning and overall quality of life," says Dr. Alibhai, a consultant in geriatric medicine. The study will be completed by the fall of 2010.

Diabetes and exercise

A randomized clinical trial led by PhD candidate Pearl Yang has identified an optimal resistance training exercise regimen for use in combination with aerobic walking for people with diabetes. Conducted with 60 patients at Toronto Rehab, the study showed that after six months, participants' depressive mood scores improved by almost 30 per cent and quality of life scores specific to diabetes increased by 7 per cent.

End-stage kidney failure and exercise

Life is far from simple for older patients with end-stage kidney failure. Hemodialysis takes up many hours each week, and often leaves people feeling tired and unwell. Many patients have other debilitating conditions, further sapping their energy. Toronto Rehab scientists Drs. Gary Naglie and Pia Kontos, along with colleagues, have designed and developed a pilot exercise program to help patients enjoy a more active lifestyle. Participants exercised during their hemodialysis sessions and at home several times a week. "Participants' ability to exercise increased, and we also saw some improvement in quality of life," says Dr. Naglie. Larger studies are needed to determine whether people's outcomes are improved over a longer period. To spread the word to health professionals and others about the importance of exercise for patients on hemodialysis, Drs. Naglie and Kontos are creating a video to more effectively convey the message that "exercise should be on everyone's radar screen because it can bring many benefits."



Dealing with diabetes at home and on the road

The wake-up call came the day Keith Bird's doctor put him on insulin to regulate his blood sugar levels, amid ever-worsening diabetes.

Bird, 69, had known the toll that a sedentary lifestyle and poor eating habits were taking on his health. At more than 350 pounds, in 2006 he had been diagnosed with type 2 diabetes. Since then, he had attended diabetes education programs, only to slip back into his unhealthy ways once he dropped their rigid regimes.

The turnaround began when the retired telecommunications expert was referred to Toronto Rehab's Diabetes Exercise and Healthy Lifestyle Service. The research-based program is designed to improve diabetes control and reduce cardiovascular disease. People with type 2 diabetes are two

to four times more likely to develop coronary heart disease than individuals the same age who do not have diabetes.

Included in the six-month program was an exercise and diet regime designed to fit Bird's busy lifestyle—both at home and on the road. There were weekly check-ins at Toronto Rehab to attend short lectures and to work out. And when Bird couldn't make it in—including when he travelled to Calgary for two months—he remained in contact virtually.

"It was a lifeline for me," he says, adding he has lost more than 40 pounds so far and significantly reduced his dependence on insulin.

Sharon Suchak, a case manager for Toronto Rehab's Cardiac Rehabilitation and Secondary Prevention Program, says the service deals with more and more patients 'remotely'. They range from snowbirds and busy executives to people with mobility problems.

"We try our best to come up with a solution for everyone," she says.

Many keep in touch by email, reporting on their heart rates, exercise routines and blood sugar levels as well as asking any questions electronically. The centre's website also provides information and videos on topics from goal-setting to foot care.

Working with clinicians, hospital

People with type 2 diabetes are two to four times more likely to develop coronary heart disease than individuals the same age who do not have diabetes.

researchers are now conducting a randomized trial of Toronto Rehab's Diabetes Exercise and Healthy Lifestyle Service. The goal: to optimize the exercise training approaches used and maximize benefits for participants.

And, in another project, the team is using its experience with the diabetes program to develop a multicultural 'tool kit' or guide that community health centres can use to help people manage their diabetes.

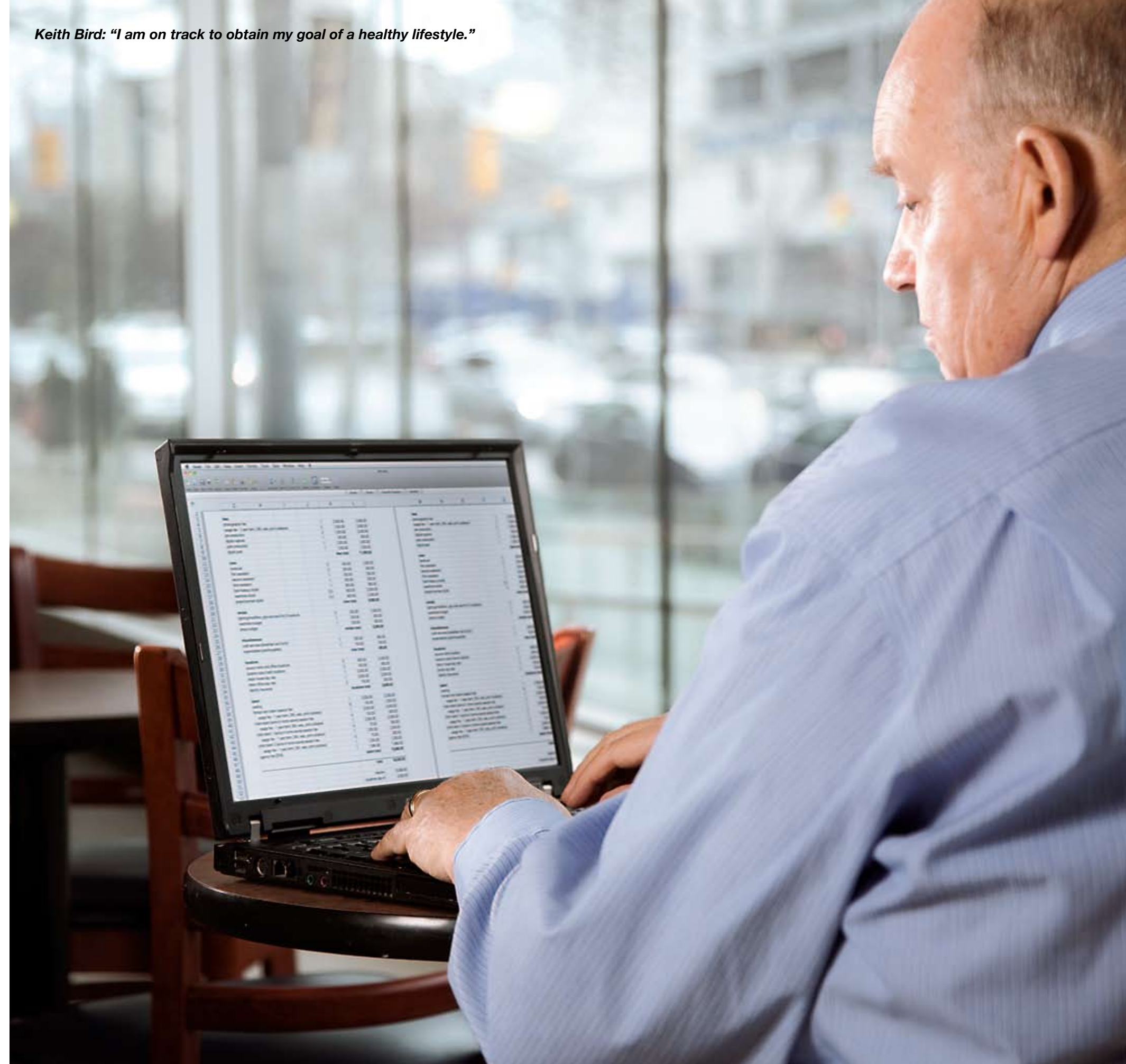
The researchers are collaborating with West Hill Community Services in Toronto.

"We realize that, to have even greater impact and reach, we need to get out into the community with our approaches to diabetes control," says scientist Dr. Paul Oh, medical director of Toronto Rehab's Cardiac Rehabilitation and Secondary Prevention Program.

For his part, Keith Bird says those approaches work for him because they are supportive yet encourage self-discipline: "I have been made to be accountable," he adds. His wife Fronnie, who has cardiac problems, has also benefitted. The couple prepare healthy meals together, and they plan to take a cruise when Bird reaches 175 pounds, something he feels is doable—and maintainable.

"I am on track to obtain my goal of a healthy lifestyle," he says.

Keith Bird: "I am on track to obtain my goal of a healthy lifestyle."



Sharon Suchak

A high-tech sugar monitor



An estimated three million Canadians have type 2 diabetes, and approximately 80 per cent of them will die as a result of heart disease or stroke. Toronto Rehab scientist Dr. Paul Oh thinks everyday technology can improve this situation. With researchers at Wilfrid Laurier University, he is involved in a study that's a first step toward developing a monitoring and alerting system to help diabetics better manage their blood sugar levels.

"Keeping blood sugar under control is a key

way to reduce the risk of heart disease and other complications," explains Dr. Oh. In the study, about 60 diabetics wore various monitors and sensors, including GPS, as they went about their daily lives. Participants also recorded their food and medication intake in a diary. The results, now being analyzed, will show how a person's daily activities, food intake and medicine use affect blood sugar control.

"With this data, we will be able to design a monitoring and alerting system that uses everyday technology, such as a cell phone, to help people better manage blood sugar levels," says Dr. Oh. "For instance, the device might detect that your sugar levels spike 15 minutes after you leave home each morning. You would get an alert so you could change that behaviour."

A 'smart' cushion

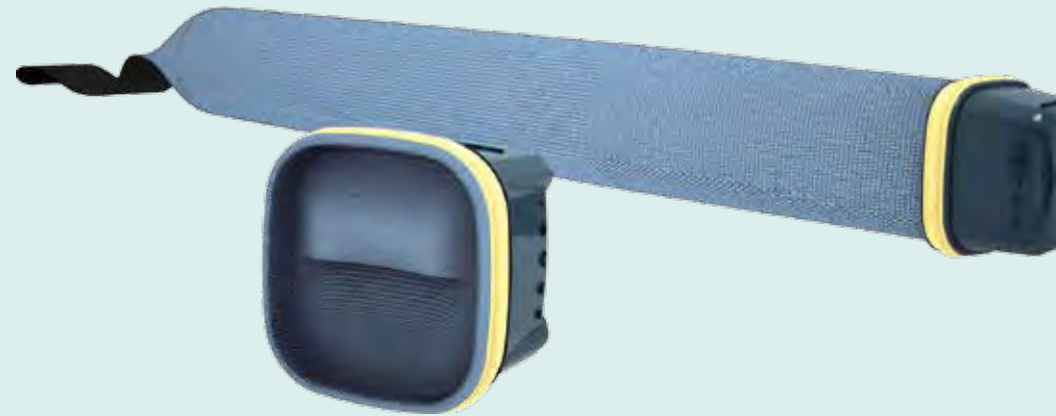
It's hard to believe sitting can be hazardous to your health. But as wheelchair users know, pressure sores can be caused by sitting improperly or forgetting to regularly change position. These sores can have serious, even fatal, consequences. "Many wheelchair users have them, and some get sores more frequently than others," says Dr. Milos R. Popovic, a Toronto Rehab senior scientist, adding that treatment and hospitalization for one pressure sore can cost tens of thousands of dollars. He's come up with a high-tech, low-cost way to prevent these sores. It's called SensiMat. Developed in collaboration with Elmedex, a Toronto-based company, SensiMat is a thin cushion that goes underneath the wheelchair cushion. Sensors inside can detect if pressure is building.

"If the person is not sitting properly or forgets to regularly rearrange their sitting position, the system tells them," Dr. Popovic explains. "It can do this in several ways, such as calling their cell phone to say: 'This is your behind calling. I'm sorry, but you're not sitting properly.'"

The team is seeking funding to conduct clinical trials.



A much-needed lift



One of the greatest challenges of home care is the task of moving someone—from a bed to a chair, or to the bathroom. The result is that too many nurses and family caregivers suffer disabling back pain and families cannot manage to care for their loved ones at home. Enter the SlingSertor™, a novel solution born in the labs of Toronto Rehab. The SlingSertor gets around a perennial problem: placing lifting slings under people is a common cause of injury. Using compressed air, the hand-held device effortlessly shoots a strap-in-a-sleeve under an immobile person. The strap 'crawls' between the person and the support surface without creating any friction, rather like two tank treads advancing back to back. The process is typically repeated three times—at the shoulders, mid-section and legs.

Once the lifting straps are in place, the person can be hooked up to a lift and raised a few inches so that a full lifting sling can be placed under with no effort. The SlingSertor straps can be pulled out with ease because the clever design causes them to turn inside out as they are pulled out, creating no friction with either the person or the bed. The researchers have had no difficulty using SlingSertor under even three researchers piled on top of each other—so it will work with some very heavy people.

The first customers are expected to be healthcare institutions, but the home market offers excellent prospects too. A device that allows informal caregivers to move those with mobility issues from a bed to a chair would make it possible for more people to stay at home, says Dr. Geoff Fernie, Toronto Rehab's vice president, research.

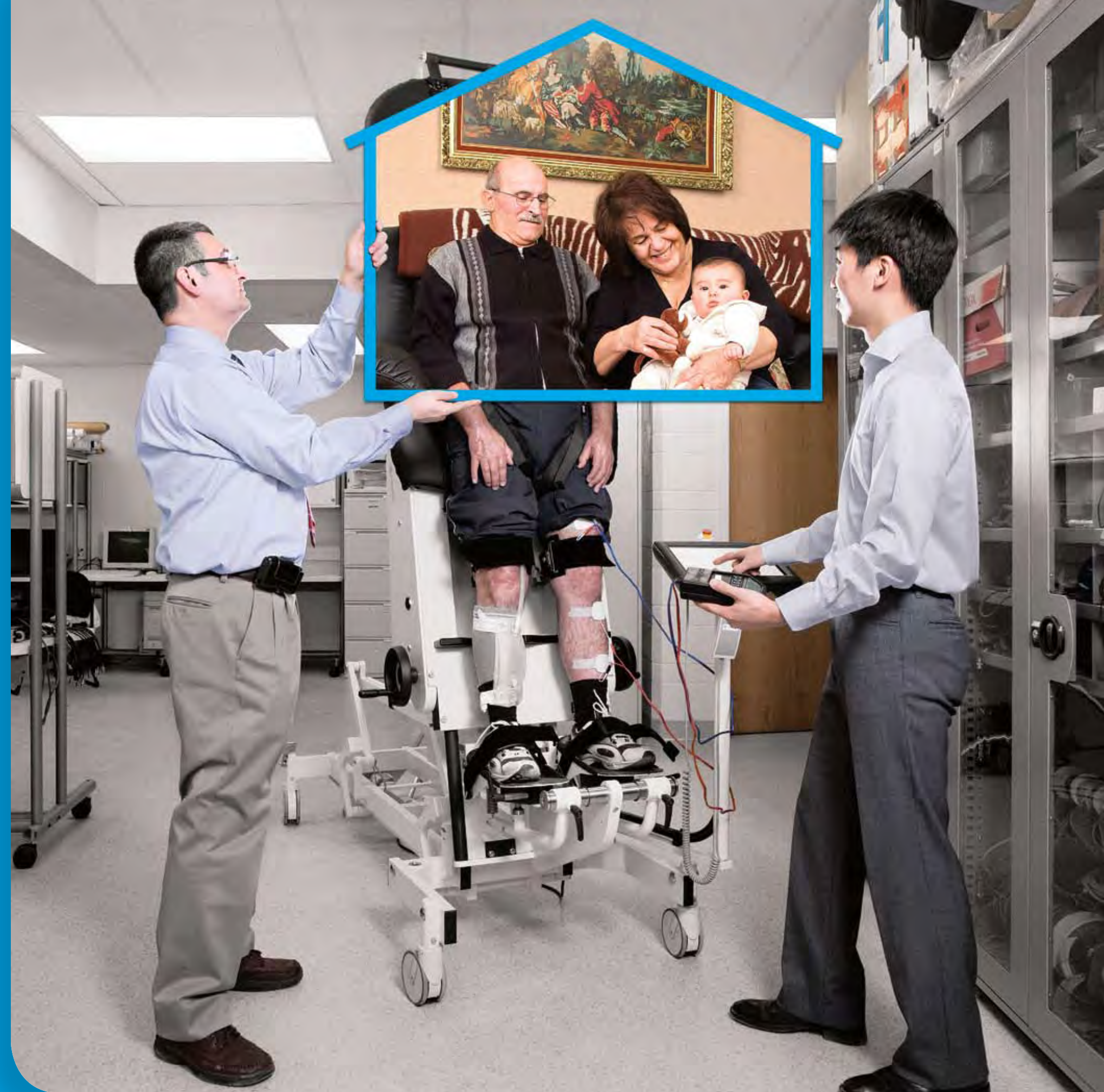


Toronto Rehab is already using several hundred devices as part of the final stages of testing. Once this is complete, the manufacturer, Andrew J Hart Enterprises Limited, will install the necessary tooling to begin full-scale production of the devices. The SlingSertor is slated to be commercially available sometime in 2010.

Getting you home from hospital

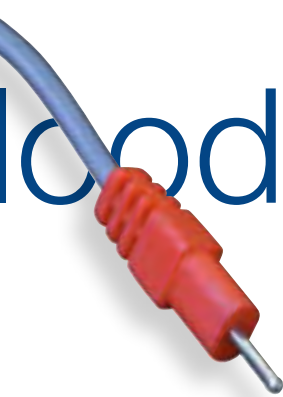
- + Paralysis and blood pressure: a stimulating approach
 - + The fine art of standing
- + A smart way to curb hospital-acquired infections
 - + Checking out and working out
 - + Going home after brain injury
 - + There's no place like home
 - + Great gadgets

So much of Toronto Rehab research is about speeding recovery and getting people home from hospital in better shape. Here, Dr. Milos R. Popovic (left) and graduate student Lorne Chi are in the lab where they are developing a way to help people with spinal cord injuries deal with sudden blood pressure drops (see Paralysis and blood pressure: a stimulating approach on page 34).



Paralysis and blood pressure

a stimulating approach



Laura Beard



When she broke her neck in a mishap two years ago, Laura Beard was determined to get moving again.

Paralyzed below the shoulders after falling from a low veranda while vacationing in Jamaica, the Toronto goldsmith and jewellery restorer started working on her rehabilitation right away. She practiced grasping objects like plastic juice bottles in an intensive care unit following spinal surgery, and took advantage of every therapy possible in Toronto Rehab's Spinal Cord Rehabilitation Program.

Today, Beard remains in a wheelchair but has regained much of the sensation in her body and the use of her left arm and hand. She

"We can send patients home from hospital faster and in better shape physically and emotionally."

– Dr. Milos R. Popovic

is able to do occasional work from her home on Toronto Island.

But, through it all, her progress has been hampered by low blood pressure. It makes her feel dizzy much of the time when upright—“like being on a roller-coaster”—and sometimes causes her to black out.

It's a condition that affects most people with spinal cord injuries, especially in the critical time following an injury, says Dr. Milos R. Popovic, a senior scientist at Toronto Rehab and holder of the Toronto Rehab Chair in Spinal Cord Injury Research. The paralysis that affects the large muscles in the legs and arms also hinders the tiny ones surrounding the veins and arteries, he explains. These normally constrict when the body is upright so that blood can reach the heart and brain in sufficient volume. But, in people who've sustained a spinal cord injury, blood pressure falls and blood pools in the legs instead.

This condition, called orthostatic hypotension, can cause patients to miss therapies and remain in bed, he says, where they often become depressed and frustrated. There they are also prone to circulatory and digestive problems, rapid bone and muscle loss and pressure sores.

Dr. Popovic's main research focus has been to develop an understanding of how the nervous system and muscles work together to control body movement. He applies functional electrical stimulation (FES) to nerves to reactivate muscles, prompting people who have had a stroke or spinal cord patients to perform and even 'relearn' actions such as grasping and walking.

Now he is using FES, combined with lower-body exercise, to help the muscles around blood vessels contract. Early studies with healthy individuals have shown that the technique is successful in

raising and regulating blood pressure when the body is tilted upright using a special examining table.

It will next be applied to patients with spinal cord injuries in a clinical setting. The goal is to retrain the body to activate the muscles voluntarily.

“We can make a huge difference for people with spinal cord injuries,” says Dr. Popovic, who is also a professor in the Institute of Biomaterials and Biomedical Engineering at the University of Toronto. “We can send patients home from hospital faster and in better shape, physically and emotionally.”

The fine art of standing

Injury or disease can rob people of the ability to stand and walk on their own. Can scientists create a device, as simple to put on as a pair of trousers, that would allow people to stand or even walk again? Developing such a device is a major engineering challenge—one that Dr. Kei Masani is on the way to solving.

An expert in human motor control, Dr. Masani, a scientist in Toronto Rehab's Rehabilitation Engineering Laboratory, is exploring the potential of a technology called functional electrical stimulation—or FES—which stimulates people's nerves with tiny electrical impulses.

“By stimulating the correct nerves in the correct order, we can cause the patient to perform a range of actions such as grasping an object or standing up,” explains

Dr. Masani. “FES is a very powerful technique.”

FES has enormous potential for people with paraplegia. It would allow some to stand up, perform ‘hands-free’ standing, and sit down. Standing not only increases the ability to perform tasks but also has important health benefits. It keeps bones strong, reduces fragility fractures and pressure sores, and regulates blood pressure and digestion. This is why people with spinal cord injuries need to stand regularly, using standing frames, braces, walkers and other aids.

Before FES can be put into wide use, Dr. Masani and colleagues need to answer some key questions, such as: exactly

which muscles are needed to maintain balance during standing? What order should the muscles contract in? And can FES produce muscle contractions that are strong enough and quick enough to compensate for unexpected disturbances during standing?

To answer these and other questions, Dr. Masani is conducting experiments with healthy subjects. “We need to learn much more about how people maintain balance while standing. Animals can stand and walk almost from birth. Humans, however, take years to learn how to stand or walk. We are bipeds, and keeping our balance while walking on two feet is not easy.

My research goal is to understand exactly how we do it.

“Robots use motors to move,” Dr. Masani adds. “Scientists can control motor force

very precisely. However, human beings rely on muscles to stand and walk—and muscles cannot be controlled as precisely as motors, either by the brain itself, or by signals from an FES device. Yet, when using FES to help patients stand and walk without losing their balance, we need to control muscle force with great accuracy. Achieving this fine control is a major challenge, and one of the issues we're working on at the moment.”

Until recently, there has been little research into how humans keep their balance. Dr. Masani is one of the few scientists applying research findings to improve rehabilitation techniques using FES.

"Animals can stand and walk almost from birth. Humans, however, take years to learn how to stand or walk."

– Dr. Kei Masani

Dr. Kei Masani (right)



A smart way to curb hospital-acquired infections

Hospital-acquired infections kill as many as 8,000 patients each year in Canada. Infection control is a major challenge—yet survey after survey shows busy healthcare professionals often neglect the most basic thing: hand hygiene.

“Conventional hand hygiene programs improve matters for a while, but eventually levels of hand hygiene drop off again,” says Dr. Geoff Fernie, vice president, research, at Toronto Rehab. “That’s why we’re working on a sustainable solution to this recurrent problem.”

Toronto Rehab’s solution is a high-tech marvel. It’s a sophisticated electronic hand hygiene monitoring system designed by Toronto Rehab’s Dr. Alex Levchenko to monitor and modify caregivers’ hand

hygiene behaviour. At the heart of the system is a ‘smart ID badge’ with an infrared sensor which is clipped to the caregiver’s pocket or worn on a lanyard around the neck. The sensor interacts with tiny infrared emitters mounted on the ceiling in the zones where hand hygiene monitoring is critical—such as patient beds, room entrances, dirty utility rooms and other areas where there is a high risk of infection.

When a healthcare worker enters or leaves one of these zones, and the person has forgotten to perform hand hygiene, the device vibrates or produces an audible prompt. If hand hygiene rules are followed, the device displays a green light.

The same device also maintains detailed data on hand hygiene habits. This data is downloaded, analyzed, and hand hygiene performance reports are generated so caregivers can see where there’s room for improvement.

Recent tests at Toronto Rehab’s E.W. Bickle Centre for Complex Continuing Care are encouraging. “The technology works, and we have seen significant changes in behaviour,” Dr. Fernie reports. “Staff are excited. As professionals, they want to do their jobs as well as possible, and the system helps them do that.”

The next step is to conduct more extensive testing in a hospital setting.

Meanwhile, researchers are building new features into the system to make it even more sophisticated. For instance, not all interactions with patients require hand washing. A conversation between doctor and patient is different from a hands-on examination.

Kaveh Momen, a doctoral candidate in biomedical engineering at the University of Toronto (U of T), is developing a way for the system to use artificial intelligence to analyze caregivers’ movements and determine exactly when they need to wash their hands.

The new system draws on the knowledge and experience of a multidisciplinary team that includes: Dr. Matthew Muller, infection control physician at St. Michael’s Hospital, Dr. Allison McGeer, director of infection control at Mount Sinai Hospital, and Dr. Veronique Boscart, Toronto Rehab nurse and research team member.

Toronto Rehab scientists are also beginning to study another basic infection control issue—how to improve handling of human waste. Initiated by Dr. McGeer, the project focuses on how waste is collected and brought to disposal units. So far, researchers have surveyed various technologies for human waste disposal.

“The idea that people go to a hospital and get sick there seems really unfair,” says Dr. Fernie. “We are pursuing promising solutions to this serious situation.”

“The idea that people go to a hospital and get sick there seems really unfair. We are pursuing promising solutions to this serious situation.”

— Dr. Geoff Fernie

Kaveh Momen and Dr. Alex Levchenko



Ceiling-mounted ‘emitters’ provide information, such as location and a patient’s contagion level, to a portable electronic device.

Dr. Veronique Boscart

This electronic device vibrates or beeps if the user forgets to wash his or her hands.

A wearable alcohol gel dispenser. When gel is used, a signal goes to the electronic device, indicating that hand washing has occurred.

HandyAudit system helps hospitals collect and analyze hand washing statistics

Given concerns about hospital-acquired infections, how are hospitals doing overall with their hand cleaning efforts? Toronto Rehab researchers have developed an easy-to-use electronic tool to help capture hand washing statistics efficiently and accurately.

Known as HandyAudit™, it’s designed to improve on the current paper-based system that requires hand hygiene auditors to simultaneously monitor and record the hand washing habits of several people at once.

The HandyAudit system consists of a personal digital assistant (PDA) and a web-based application. While observing the activities of several healthcare providers at a time, auditors use touch screen technology to simply input actions into the PDA. Auditors record typical activities such as: entering the patient’s room, touching the patient, cleaning open wounds, using an alcohol gel hand sanitizer or leaving the patient’s room.

The data is downloaded from the PDA to a secure website. The HandyAudit software analyzes the actions and then calculates hand hygiene compliance rates.

Infection control physician Dr. Matthew Muller can speak to the challenges of observing and inputting hand hygiene compliance data. He is responsible for monitoring hand hygiene compliance at St. Michael’s Hospital in Toronto.

“Keeping your eyes on several healthcare workers at once while simultaneously interpreting and recording whether or not a person has washed their hands before and after touching a patient or performing a medical procedure can be extremely demanding,” he says. “There is also potential for error when inputting and transcribing that information.”

This novel technology relieves some of those demands because it requires you to just enter what you see.”

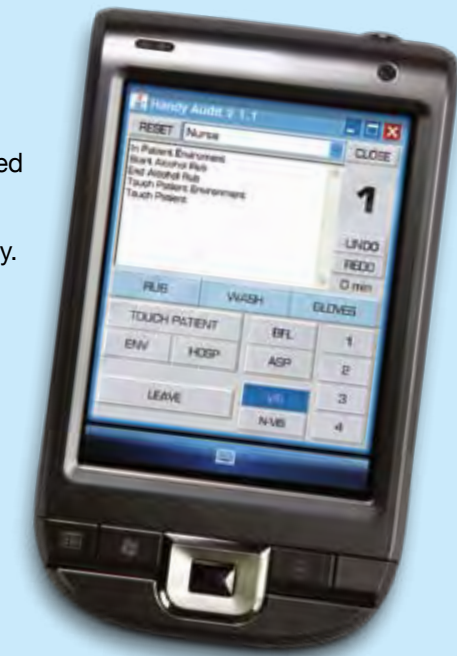
HandyAudit has another significant advantage—it can help reduce costs. “Current hand hygiene auditing processes are extremely resource-intensive,” says Dr. Muller, who helped with HandyAudit’s development. “This device could save hospitals money and time by simplifying auditor training and eliminating the need to transcribe information from paper to computer.”



Dr. Matthew Muller

The Ministry of Health and Long-Term Care requires all Ontario hospitals to publicly report their annual hand hygiene compliance rates. Beyond Ontario’s borders, the HandyAudit software can be tailored to different jurisdictions worldwide to help them with their hand hygiene compliance requirements.

For more on HandyAudit, www.handyaudit.com



Checking out and working out

When patients get ready to leave hospital, their rehabilitation teams usually underline the importance of exercise to ongoing recovery. But for some patients, it's hard to get going again once home.

So Toronto Rehab senior scientist Dr. William McIlroy and colleagues are in the early development stages of several projects—currently focused on stroke and orthopedic patients—to help ease the transition from hospital to home, and encourage people to keep up their activity levels.

Notably, they are working on a 'kiosk' version of Toronto Rehab's new Balance, Mobility and Falls Clinic, where researchers and clinicians apply technology never before used outside of the research lab to assess the balance of people who have had a stroke. By receiving detailed balance and walking assessments beyond what can be observed by the human eye, therapists can tailor exercise programs

to better prepare patients to safely return to community life. The kiosk version will be a smaller and less expensive version of the Toronto Rehab clinic-based technology that can be installed at other hospitals, so that therapists can conduct assessments of their patients before discharge.

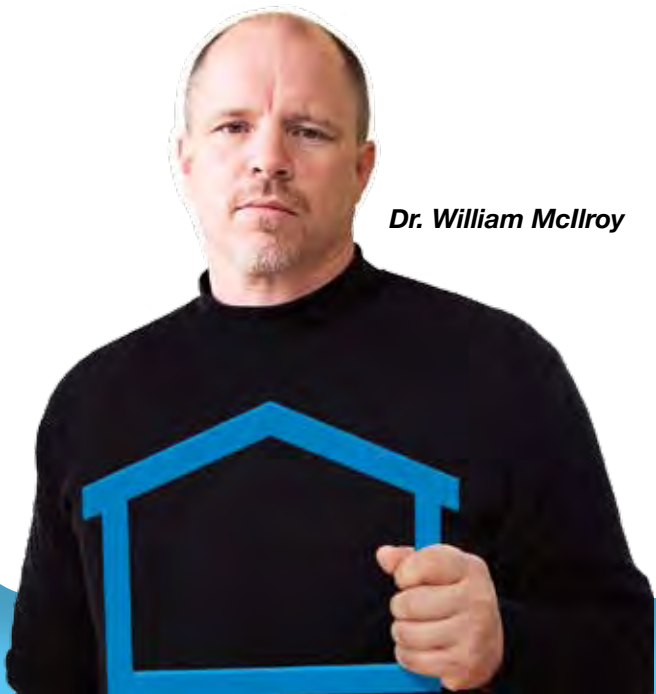
Dr. Kathryn Sibley, a Toronto Rehab postdoctoral research fellow, is also surveying physiotherapists across Ontario to determine what balance assessment tools they are now using in their clinical practice for various types of patients. Focusing on therapists who work with orthopedic patients, she hopes to provide additional tools that will build interest in the kiosk approach.

Another project in development involves the design of an information and aerobic exercise program that people who've had strokes can use at home, while remaining connected to hospital. A web-based resource will help track their activities and progress, and keep them connected with the rehab team. "Folks just need assistance and guidance, and this package would help them remain as active as possible once they get back home," says Dr. McIlroy.

Design elements may include wireless instruments to monitor vital statistics such as heart rate, and web cam technology that allows people to join a virtual exercise class from home.

"Folks just need assistance and guidance, and this package would help them remain as active as possible once they get back home."

— Dr. William McIlroy



Dr. William McIlroy



A stroke patient is assessed in the Balance, Mobility and Falls Clinic by Dr. Avril Mansfield (left) and Liz Inness, a physiotherapist at the helm of the clinic.

Going home after brain injury

For people with traumatic brain injury, returning home from hospital offers a new beginning—and many challenges. Even the first cup of coffee out with a friend can be difficult.

"Sitting up correctly and balancing a coffee cup can be hard. So can keeping up a conversation if you aren't noticing social cues and body language," says Dr. Robin Green, a Toronto Rehab scientist and neuropsychologist.

By providing insights into how the brain recovers and relearns after injury, Dr. Green aims to help people function better in the community after they leave hospital. Her groundbreaking work recently earned her a prestigious Tier 2 Canada Research Chair in Traumatic Brain Injury—Cognitive Rehabilitation Neuroscience, University of Toronto. At U of T, Dr. Green's primary appointment is in the Department of Psychiatry, and she leads the Social and Cognitive Sciences field of the Graduate Department of Rehabilitation Sciences.

Right now, Dr. Green is in the midst of a fascinating study at Toronto Rehab. The

question: what happens when patients with head injuries get twice as much therapy each day during their hospital stay? The point is not to shorten the stay, but to intensify treatment. Dr. Green says this approach has worked well for stroke survivors, for whom it speeds up recovery and improves motor and cognitive functioning. But there is little research on the effect of extra therapy for people with traumatic brain injury.

Dr. Green believes doubling the hours of therapy may also help with something else. Her research has shown that some people who sustain blows to the head experience a second wave of damage or 'sub-acute atrophy'. These troubling findings help explain why some people show poor recovery after brain injury. "We think intensifying therapy early on should help offset atrophy and enhance the brain's recovery," she explains.

"If you can improve people's functioning earlier on, then you put them in a position where they can better engage in the environment. We believe that this will prevent a 'use it or lose it' related atrophy."

Dr. Geoff Fernie, Toronto Rehab's vice president, research, believes Dr. Green's findings may lead to radically new treatment approaches to fend off possible 'sub-acute' damage. He imagines two phases of hospital treatment. "It may be that, for some people, it's possible to provide hospital therapy for a while, then send them home

and then bring them back again to prevent a secondary decline."

Making the most of hospital time is crucial, but so is optimizing recovery at home. Dr. Green is in early discussions with colleagues about ways to provide people with what she calls "maintenance therapy" once they leave hospital—"a kind of therapy that can be self-administered through technology." She is interested in developing a device, similar to a Wii system, which would "allow people to stimulate themselves cognitively, physically, emotionally at home, so that they could continue their therapy at home."

Unfortunately, for many survivors of brain injury, the return home comes with psychological distress. To provide support, Dr. Green and colleagues have taken a well-proven therapy, adapted it for brain injury, and delivered it by phone as well as face-to-face. Early results show that this cost-effective approach results in significantly improved emotional functioning and diminished distress. "It also improves community integration, meaning less

reliance on caregivers and the medical system, as well as a better chance of return to employment," she says.

Dr. Green's work has implications for many patient populations, including stroke survivors and the elderly. "The principles of deterioration of the brain are common across different populations, so advances we make here are relevant to others."

Interestingly, she notes that a handful of hospitals now have 'brain repair research units' where the research involves different types of patients and conditions.

Dr. Fernie would like to see this happen in clinical practice at Toronto Rehab too. He can see the merit of moving away from condition-based clinical programs, such as neuro rehabilitation and geriatric rehabilitation, and instead creating a kind of brain enhancement centre.

"If you can improve people's functioning earlier on, then you put them in a position where they can better engage in the environment."

— Dr. Robin Green



Dr. Robin Green

There's no place like home



Louis Benitez with wife Elvia: "I am 80 per cent back to my regular life in the community."

From the moment he could form a clear thought after awakening in hospital from a four-month coma, Louis Benitez set his sights on going home. It was a tall order for someone who was lucky to be alive; the ravages of botulism, a severe form of food poisoning, left him unable to see clearly, and he couldn't talk, feed or dress himself, get out of bed or walk.

Benitez was so debilitated that, until recently, he would have been deemed unable to participate in active rehabilitation and could have faced a long stay in a complex continuing care hospital or long-term care facility (nursing home). But thanks to an innovative new research-based approach known as low tolerance, long duration rehabilitation—tailored for people who cannot endure high-intensity rehab—seven months later, Benitez was back home.

Day by day, his independence is increasing. He is walking with a cane, driving and hopes to return to part-time work. "I am 80 per cent back to my regular life in the community," he proudly states.

Low tolerance, long duration rehabilitation is part of a huge shift in complex continuing care fuelled in part by an expected doubling of seniors in Ontario



Dr. Walter Wodchis



over the next 15 years. Changes to long-term care will follow as cost of care and quality of life are major issues for the baby boom generation, now reaching its senior years.

Dr. Walter Wodchis, a Toronto Rehab scientist and University of Toronto health care economist says recent studies have shown that "at least 50 per cent of people on long-term care wait lists don't need to go

into long-term care." In addition, he notes that "once you put someone into an institution, you start doing things for them that they used to do for themselves, so their functional capacity immediately drops."

True cost comparisons between living in institutions such as complex continuing care or long-term care versus living at home with home care support are difficult because of the hidden costs of informal caregiving provided by family and friends in the home setting. Generally, complex continuing care is about four times as expensive as long-term care, which in turn costs the province approximately four to seven times as much as maintaining people in the community with home care services (see sidebar).

Early evidence of the shift to community living can be seen at Toronto Rehab's E.W. Bickle Centre for Complex Continuing Care where, in the past, patients too medically complex for nursing homes have been

admitted, often for the remainder of their lives.

"We have experienced a fundamental revolution in complex continuing care—especially with our new low tolerance, long duration rehabilitation service, where we admit the most complex patients from our acute care partners and offer them the hope of returning home," says medical director Dr. Ken Uffen.

Patients who either graduated to high intensity rehabilitation or were discharged home increased from 43 per cent when the service was introduced in 2007-2008 to 74 per cent as of the end of September 2009.

A much-anticipated overhaul of long-term care has yet to materialize, although leaders in that sector say it's only a matter of time.

"Acute care is about moving patients along; now complex continuing care is looking more at how we move people through the

system and that's going to work its way into long-term care as well," says Dr. Ray Berry, medical director of Lakeside Long-Term Care Centre, a partnership between Toronto Rehab and Extendicare Canada Inc.

"Reallocation of healthcare budgets toward home care would be required if we are to maintain an aging population in the community." Dr. Berry believes it's important to also address the lack of social support for seniors living in the community and the retrofitting of their homes to make them accessible and safe.

Paul Tuttle, president of Extendicare Canada, agrees that change is coming to long-term care and he welcomes it. "It becomes a self-fulfilling prophecy that we institutionalize people if we build all these

Costs and hidden costs of care

\$30,000

Annual minimum Ontario government contribution to maintain a person in long-term care/nursing home (not including the resident's co-payment)

\$6,000 - \$6,500

Annual cost to maintain average home care client who is at high risk of going into long-term care

\$4,000 - \$4,500

Annual cost to maintain average home care client who is at low risk of going into long-term care

- What is not included in the home care costs: informal care provided by family and friends. An estimated 75 per cent of the resources that go toward maintaining a person at home are informal.

- If a home care client has either a live-in spouse or child who is providing care in the home and is not experiencing caregiver distress, the client's risk of going into long-term care is reduced by more than 50 per cent.

nursing homes," he says. "It sounds odd because I'm in that business but diverting people away from nursing home beds is a good trend, allowing the beds to be used by those who really need that level of care."

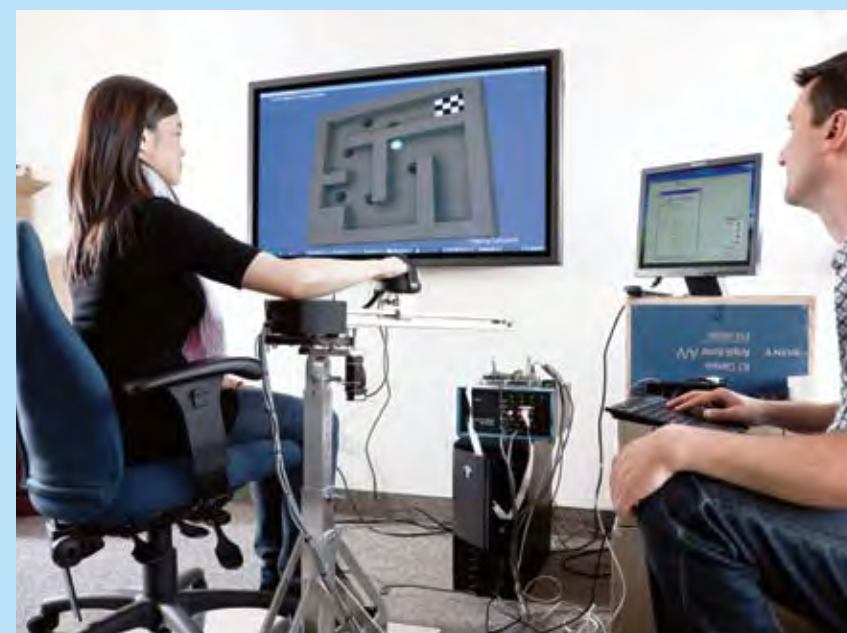
Tuttle believes nursing homes in communities without rehab hospitals can take on the role of inpatient and outpatient rehabilitation, and provide a short-term placement for people recovering from an acute hospital stay. He also sees nursing homes changing focus to palliative care, and "admitting people who are very, very old and frail during the last six months of their lives instead of the last two to three years."

Video-game therapy

Toronto Rehab researchers are teaming up with Algoma University in Sault Ste. Marie, Ontario, to bring the excitement of gaming technology to speech-language therapy. The goal is to take speech language techniques usually used one-on-one in the clinic and turn them into computerized, game-like applications, says Toronto Rehab senior scientist Dr. Elizabeth Rochon.

Gaming technology experts at Algoma and the Toronto Rehab team want to use technology to make language therapy “more fun and engaging” for patients with language disorders. From the clinician’s point of view, video-game therapy could be a time-saver because the program would be easily customized to the patient. Patients could play on their own time, either in hospital or at home, and potentially with a family member, Dr. Rochon adds.

Rehab robot



After a stroke, many people need to regain upper body strength so they can resume daily activities. That can mean therapists and patients spending a lot of time together, often doing repetitive exercises. Toronto Rehab scientist Dr. Alex Mihailidis is working with Quanser Inc., a local company, to develop a new approach to strengthening that aims to keep boredom at bay. It starts with a robotic arm that patients slide back and forth in a reaching motion. But there’s more: computer video games give people targets to reach—such as guiding a ball through a maze. Thanks to artificial intelligence, sensors can detect if patients are performing tasks correctly and how well they are progressing over time. The robot adjusts accordingly, increasing or decreasing the level of intensity. If the patient seems to be losing focus, the robot switches to a different game or reminds the person to stay on task.

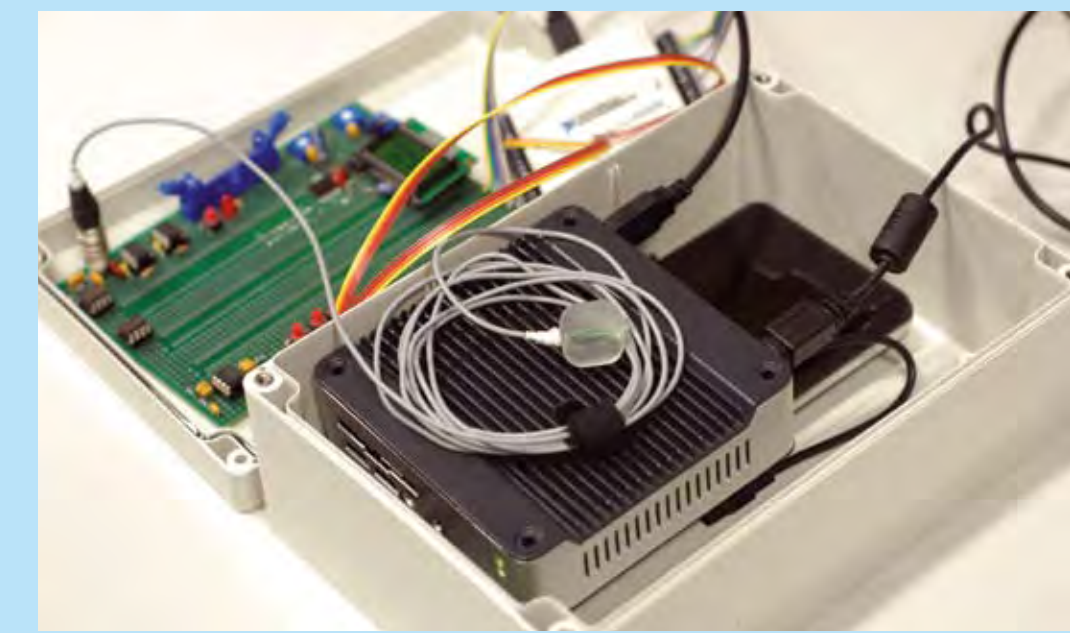
“The device is easy to use anywhere and at any time, whether by the bedside in hospital or at home,” says Dr. Mihailidis. “We think it will encourage more frequent exercise, and facilitate a quicker return home.”

Wireless walking

Hospital patients may be enthusiastic about exercising when they are with their therapist. But what happens when the therapist goes away? Not much, according to scientists who have developed a novel way to measure patients’ walking activity in hospital. More than 20 patients in Toronto Rehab’s stroke rehabilitation program wore wireless sensors from morning to evening. The sensors collected data on everything from steps per minute to walking quality. Data was transmitted to a personal digital assistant (PDA), worn by the patient.

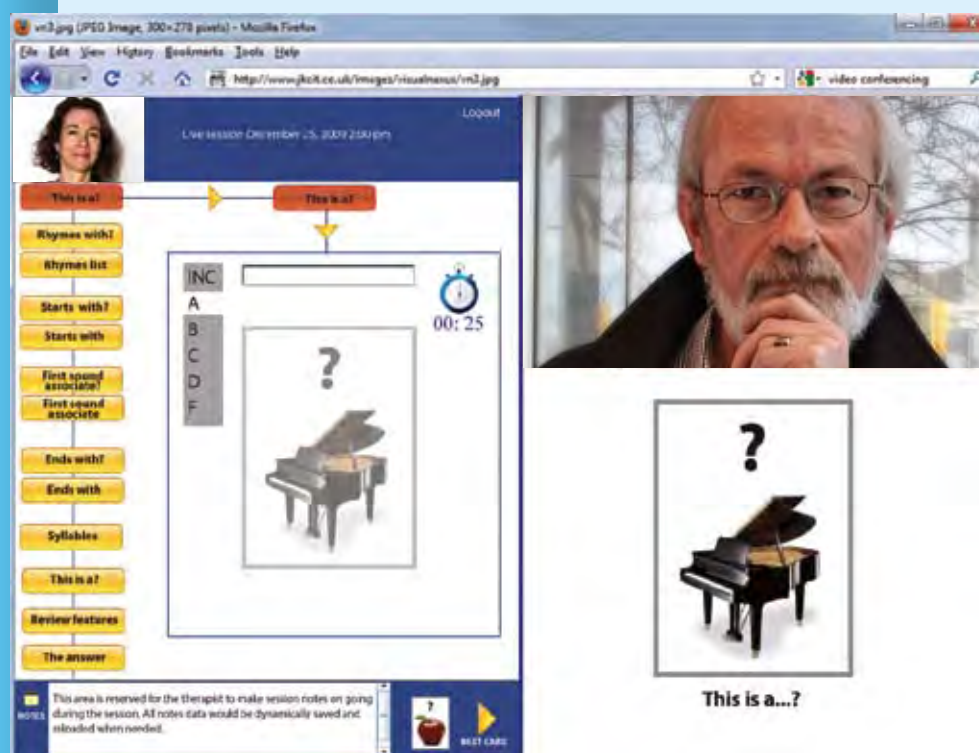
“The therapist and patient can use this information to guide activity outside therapy—and to take advantage of all that time during the day when the person could be engaged in beneficial walking activity,” says Dr. William Gage, a scientist at Toronto Rehab and assistant professor in the School of Kinesiology and Health Science at York University. It’s also hoped that ‘intensifying’ therapy in this way will speed up recovery and a patient’s return home. Ultimately, people will be able to use the sensors at home too, adds Dr. Gage, who is working with University of Toronto master’s student Sanjay Prajapati and other researchers at U of T, University of Waterloo and Sunnybrook Health Sciences Centre.

Aspiration detector



For most of us, swallowing seems like the most natural thing in the world. But swallowing doesn’t come easily for everybody. Dysphagia (difficulty swallowing) can affect all kinds of people, including those with Parkinson’s or brain injury, stroke survivors and the elderly. Sometimes, people with dysphagia inadvertently let food or liquid go into their windpipe or lungs. This can lead to fatal pneumonia. Toronto Rehab senior scientist Dr. Catriona Steele and Dr. Tom Chau, a scientist at Bloorview Kids Rehab, are designing an ingenious way to detect whether someone has inhaled food or liquids—or is at high risk of doing so. It’s a simple, portable device that measures sound wave vibrations on the surface of the neck as someone swallows.

“When fully developed, this device could be used both in hospital and at home to ensure that aspiration of food or liquids has not occurred,” says Dr. Steele. “If there’s evidence of aspiration, interventions can be quickly implemented, reducing the risk they will go on to develop pneumonia.” Panacis, an Ottawa-based company, aims to make the ‘Aspirometer’ device commercially available.



Influencing healthcare stimulating the economy

- + Research in action: influencing policy and the healthcare system
- + Fuelling growth: jobs and the economy
- + Team Robot: a promising partnership
- + Quanser: a success story in rehabilitation technology

Research in action influencing policy and the healthcare system



Dr. Susan Jaglal (centre)

Like scientists everywhere, Toronto Rehab researchers share their findings by publishing in scholarly journals. They also spread the word about their work in other ways—such as sharing their knowledge directly with decision-makers.

For Dr. Geoff Fernie, Toronto Rehab's vice president, research, this means applying his expertise in accessibility to new rules that will make Ontario buildings accessible for all. It's part of his role as a member of Ontario's Accessible Built Environment Standards Development Committee, which is developing new standards to govern Ontario's built environment, including new construction and renovations.

Another Toronto Rehab scientist, Dr. Kathy McGilton, is contributing to policy development by commenting on draft long-term care regulations for Ontario, and offering suggestions. "It's every researcher's hope that their research will actually guide policy," says Dr. McGilton, who was asked by the Ministry of Health and Long-Term Care (MOHLTC) to review regulations in the area of dementia, skin care, falls prevention and restraint.

Toronto Rehab researchers also conduct Ministry-directed research projects that draw on their research expertise. Take, for instance, the challenging issue of patients occupying beds in acute care while they

wait for long-term care beds. Ministry officials turned to Toronto Rehab to look at existing strategies and make recommendations to help address this situation.

"Our report was tailored to specific Ministry questions and needs, and will help inform their decisions on this important issue," says Dr. Susan Jaglal, one of the Toronto Rehab scientists who worked on the project. The report produced a wide range of practical recommendations, based on successful approaches taken by various hospitals across Ontario.

In another project, Toronto Rehab scientist Dr. Walter Wodchis is helping the Ministry to determine how best to measure, and report on, return on investment in health technologies and clinical innovations. "It's easy to quantify how much is spent in healthcare, but harder to evaluate the value to Ontarians," says Dr. Wodchis, a healthcare economist.

Toronto Rehab researchers shape policies and practice in other ways. A special unit known as SPARC—the Strategic Policy and Research Communications Unit—ensures that research results go directly into the hands of policymakers so they can be used when decisions are made.

Below are some of the ways in which practitioners and planners are embracing Toronto Rehab research and applying it directly to the healthcare system:

Enhancing client-centred care

The Research Client-centred care is a term often used but not always well understood, even by the very people who care for patients. A recent survey of Ontario long-term care homes identified a need for greater support to make this philosophy part of everyday practice. Dr. Pia Kontos, a Toronto Rehab scientist, is known for her research with people with dementia and how they continue to express their individual identity, or 'selfhood,' through



Dr. Pia Kontos

selfhood, interactions between them improve, and the use of psychotropic medications and other forms of restraint declines. She decided to communicate her findings by developing a series of vignettes about practitioner-client interactions to show caregivers what client-centred care actually looks like.

The Result The vignettes have burst into cyberspace where they are reaching practitioners through an e-learning course developed by the Registered Nurses Association of Ontario, with funding from the MOHLTC. Launched in summer 2009, the online course is available to nurses and personal support workers in Ontario's 400 long-term care facilities. "This has enormous potential to change attitudes and practice by increasing understanding of client-centred care," says Dr. Kontos, a CIHR New Investigator.

Addressing a brain-injury info gap

The Research Brain injury is a leading cause of death and disability, yet there has never been a centralized dataset to assist in planning and evaluating services for brain injury survivors. Dr. Angela Colantonio, a senior scientist at Toronto Rehab, led an ambitious project to create a registry with information on Ontarians living with traumatic and non-traumatic brain injuries. The dataset gives service providers an accurate picture of brain injury in their geographic region, including

actions and gestures, even when words fail. Her pilot research shows that when caregivers respond to residents' expressions of

incidence and prevalence, and information on survivors such as age, gender, type of brain injury, and which services they use and where.

The Result Launched in mid-2009, the registry is already being used by planners at some of Ontario's local health integration networks (LHINs), says Dr. Colantonio. "Providers are using this vital data for planning, placement and budgeting, and ensuring the right services are provided."

A new approach

The Research

Usually, hip-fracture patients who have dementia-like symptoms are moved directly from acute care to a nursing home. The reason? A belief that these patients can't endure or benefit from an active rehab setting. But Toronto Rehab researchers challenged that assumption. Senior scientist Dr. Kathy



Dr. Kathy McGilton

McGilton and colleagues developed a new model of care for hip fracture patients with cognitive impairment. The results show that, with a creative, sensitive and personally tailored approach, these patients can do just as well in active rehab as those who are cognitively intact. The key is to provide staff with a greater understanding of cognitive impairments—and the skills, knowledge and support needed to relate to patients with these conditions.

The Result More than 30 healthcare institutions across the Greater Toronto Area (GTA) have implemented the new model of care. An evaluation of the model of care focused on long-term patient outcomes is now underway in two hospitals outside of the GTA, led by Dr. McGilton.

Fuelling growth jobs and the economy



Gilad Shoham

Gilad Shoham, an ambitious young product designer working with Toronto Rehab's Dr. Geoff Fernie, had a simple idea for stemming the spread of disease in hospitals.

Four years later, he's chief executive and part-owner of Medonyx Inc., a fast-growing Toronto-based medical device maker with 35 employees and millions of unit sales around the world. His big idea—the gelFAST™ hand sanitizer on a belt-clip—has become the springboard for a long list of hygiene products sold as far afield as Australia and Spain.

Medonyx's success on the world stage is a testament to Toronto Rehab's expanding role as an incubator for innovative, high-tech medical device makers. The company is among a roster of thriving small and mid-sized local companies that can trace their roots directly to the patient units, labs and workshops of Toronto Rehab, including Andrew J Hart Enterprises Limited, Staxi Corporation and Quanser Inc. All of them sell most of what they produce outside Canada.

"It's not accidental," explains Dr. Fernie, Toronto Rehab's vice president, research. "We live in an environment with patients

and clinicians. So it would be a waste of resources for us not to focus on the more applied end of the scale. Commercialization is just one, and a very deliberate, strategy to make sure that what we are doing is useful."

In addition to hand sanitizers, the hospital's busy labs are helping to feed a pipeline of new commercial products, including patient lifting devices and an array of rehabilitation and home care tools. "Many quite significant products are coming out now," Dr. Fernie says.

Ontario, and Toronto in particular, is developing a well-earned global reputation as a hotbed of medical device innovation. And Toronto Rehab is right in the thick of it. Dr. Fernie credits the city's impressive mix of world-class medical institutions, universities and research labs. That has made the city a magnet for bright researchers and inventors such as Medonyx's Shoham.

There's often a sense in government, and among funding agencies, that what the system really needs is more dealmakers and intermediaries to move good ideas out of labs and into the global market. Because it is both a lab and a potential customer, Toronto Rehab operates under a

"We focus on moving ideas into tangible, attractive prototypes that are testable and can attract investment."

– Dr. Geoff Fernie



A healthcare worker in El Triunfo, Peru, uses gelFAST

very different model, choosing to work with companies all the way from conception to commercialization.

"We focus on moving ideas into tangible, attractive prototypes that are testable and can attract investment," says Dr. Fernie. "We develop the prototypes together, and then go together to get investment and get them moving."

The hospital has developed a deep

well of experience in designing devices, making prototypes, exhaustively testing them, patenting the intellectual property, and ultimately, taking them to the market. And now Ontario is repatriating the profits, the ownership and the bulk of the economic benefits.

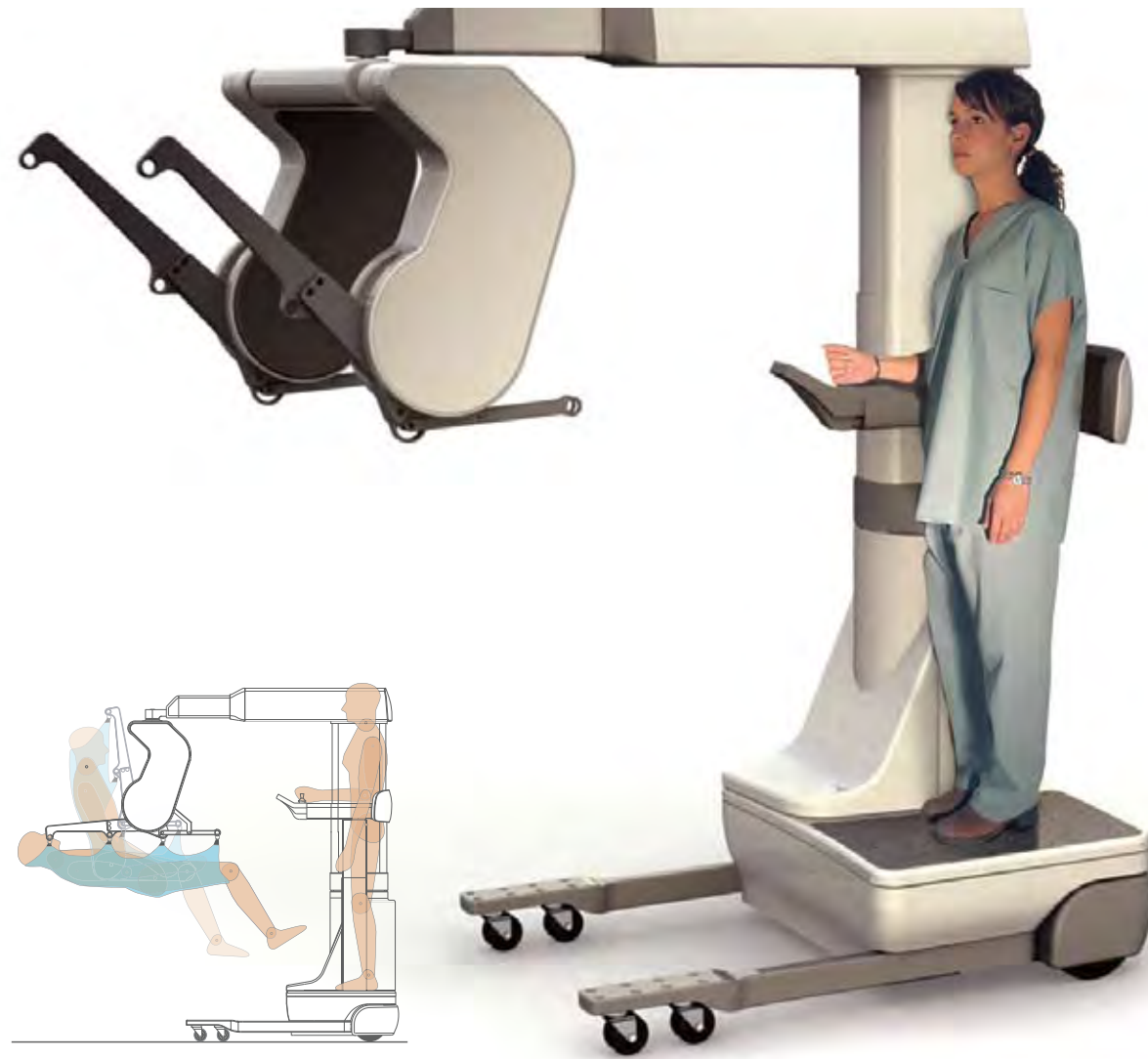
"Medonyx was really nurtured in the early stages in Geoff Fernie's lab," confirms Shoham, 34. In those days, while running

his company on a shoestring out of the basement of his suburban Toronto home, Shoham tapped the hospital's machine tools to make prototypes and used its patient units to test products.

"It was a very safe environment to grow the business out of," says Shoham, who has since moved his company into an office building in North Toronto, close to the city's busiest highway.

Team Robot

a promising partnership



Many of Toronto Rehab's research and development resources are now coming together in a flagship project—a Canadian government-sponsored joint venture with China to produce a sophisticated patient lifting robot, known as RoboNurse.

The ride-on machine is designed to take a load off the backs of caregivers who are dealing with a growing population of obese patients. Guided by a trained nurse, the robot can lift very heavy patients out of bed and move them to a chair or down the hall for tests.

A prototype of the robot was developed and tested at Toronto Rehab. Now, with matching grants of \$1-million from the Canadian and Chinese governments, the institution has teamed up with Canadian and Chinese manufacturers to bring the ambitious concept to fruition. The three-year effort, now in year one, combines a Canadian idea, research and engineering

"We can do a lot more work for way less money."

— Andy Hart

with low-cost Chinese manufacturing. The goal is to produce a device that could one day become ubiquitous in healthcare facilities and homes around the world—a market potentially worth hundreds of millions of dollars. Under the deal, the Canadian partners will get the European and North American markets, while the Chinese will get the Asian markets. "We are able to succeed by combining

the advantages of both countries, and potentially, by combining the markets in China and Canada," Dr. Fernie says.

"Our strategy is to do the development and engineering in Ontario and to own the technology. Then, to remain competitive, we'll do some selected manufacturing through our own network in China. Wherever possible, we will manufacture components and systems using highly automated low-cost manufacturing methods in Canada."

The only way to compete in the medical device business is do at least some of the manufacturing in lower-wage China, according to Andy Hart of Andrew J Hart Enterprises Limited.

"We can do a lot more work for way less money," says Hart, who was on former Prime Minister Jean Chretien's 1994 Team Canada mission to China and began making products there a decade later. "I don't know a single competitor who is not doing some

of its manufacturing in China."

Hart Enterprises, along with electronic controls specialists Quanser Inc., are the Canadian private-sector partners in the Canada-China RoboNurse joint venture.

Dr. Fernie is well aware that manufacturing offshore is a controversial strategy. He points out that making even simple prototypes of devices can cost as much as ten times more in Canada, potentially condemning brilliant ideas to

obscurity and failure. Instead, Toronto Rehab and its partners are leveraging the Chinese connection to get the most out of Canadian know-how, and research and development.

Says Dr. Fernie: "By being more competitive and creating larger international markets for our products, we will be able to create more high-skill and highly paid jobs in research, design, development, high-tech manufacturing and marketing for Canadians."



A videoconference with Shanghai University. In foreground: scale models of RoboNurse

Quanser

a success story in rehabilitation technology



Paul Gilbert

Take the wheel of an Xbox racing console, and you can actually feel the pull of corners, the shudder of the wheels or the bump of a rival car. The way the device replicates the forces and resistance experienced by real drivers is an application of computer

haptics, or the sense of touch.

Quanser Inc., a Markham-based engineering and consulting firm, is using similar advanced haptics to tackle some major rehabilitation challenges, such as gingerly lifting heavy patients and helping stroke survivors work on their own to regain strength.

For three years now, the company has been working with Toronto Rehab to design the control systems for some of the hospital's most promising robotic devices, including the RoboNurse patient lifting system and a rehab tool for stroke survivors.

The relationship with Toronto Rehab has helped the 20-year-old company grow its medical-related business from nothing to as much as 15 per cent of sales in 2009.

"For us, this kind of collaboration is extremely valuable," says Quanser president Paul Gilbert. "We're working on commercial spinoffs that can be used in all kinds of other applications."



Dr. Jacob Apkarian, Quanser's founder and chief technology officer

Quanser is perfecting fine motorized robotic control technology that it hopes to spread to other medical devices, including a sophisticated remote training device for surgeons.

"For us, this kind of collaboration is extremely valuable. We're working on commercial spinoffs that can be used in all kinds of other applications."

– Paul Gilbert

Quanser's sales grew 30 per cent in 2009, and roughly three-quarters of those sales are outside Canada. Its expanding workforce numbers 40 employees, including 19 engineers. The company is part of a growing stable of businesses now working closely with Toronto Rehab to take bright ideas and turn them into commercial products with export potential.

At this stage, many of these devices are expensive prototypes. But Gilbert is excited about the vast global potential for using

robots to make life easier for caregivers—in hospitals and at home.

"It's very expensive now," Gilbert says, "but if we can get more people aware of the technology and the potential it could spawn all sorts of activity in home robotics."

Quanser's first collaboration with Toronto Rehab was to help make a device that would help stroke patients rebuild upper-body strength. With the device, patients can do complex exercises unsupervised, using artificial intelligence and force feedback to cater the resistance to their needs.

Watching companies such as Quanser parlay their work with Toronto Rehab into an expanding global business is exhilarating, says Dr. Geoff Fernie, Toronto Rehab's vice president, research.

"There's nothing more satisfying than seeing something that we helped to develop out in the real world," he says.

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Adam Sobchak
Industrial Designer

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Research Assistant

Alexander Levchenko, PhD
Control Systems Specialist

Almir Alicelebic
Research Coordinator

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Research Associate

Anastasiya Kalnenko, BSc
Research Assistant

Andrea Brown, BSc, CDT
Research Assistant

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Research Associate

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Research Associate

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Senior Machinist

Dan Smyth, BASc, PEng
CAD Specialist

Daniel Hill, RPSGT
Sleep Lab Technologist

Darek Wojtowicz, MCSE
Computer Support Specialist

Dayle Levine, BPHE
iDAPT Project Manager

Egor Sanin, BSc
Research Engineer

Farnoosh Farahani, BSc
Research Associate

Fiona Rankin, BSc, RPSGT
Sleep Technician

Gerry Griggs
Senior Electronics Technologist

Hannah Cheung, BSc
Research Technician

Janis Andrews, RN, BSc
Project Manager

Jasmin Corbie, BA
Research Associate

Jean Hum, MSc
Research Assistant

Jen Tinning MSc, PEng
Research Technician

Jennifer Mokry, MSW
Project Manager, SCORE

Jennifer Yong-Yow, BAS
Computer Support Specialist

Jessica Neuman, MA
Research Coordinator

Jude Delparte, MSc
Research Coordinator

Judy Gargaro, BSc, MEd
Project Coordinator

Julie Mendelson, PhD
Scientific Writer / Editor

Kadeen Johns, BA
Research Admin Assistant

Karen Lepper, BA (Hons), CRA
Research Coordinator

Research Support

Karla Fisher, MSc
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Research Associate

Kent Lee, BArchSc
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Laura Laird, BA
Research Secretary

Laura Langer, BSc (Hons)
Research Assistant

Lauren Drvaric, HBSc
Research Associate

Le-Anh Ngo Chiang, MSc
Psychometrist

Li Chen, CGA
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Lily Miguel-James, MA
Psychometrist

Linda Iwenofu, BSc (Hons)
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Electronic Resources / Systems Librarian

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Research Ethicist

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Research Assistant

Mohamed Oshalla, MHSc
Research Associate

Naaz Kapadia, MSc
Research Coordinator / Physiotherapist

Narine Rambali
Machinist

Natalia Nugaeva, PhD
Research Assistant

Novlette Fraser, MA
Research Associate

Olivia Garay, BA, RPSGT
Sleep Technician

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Psychometrist

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Research Associate

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Chief Technician Sleep Lab

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Data Entry Clerk

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Senior Financial Analyst

Sandra Sokoloff, MLIS
Administrative Assistant

Shaghayegh Bagher, BASc
Research Assistant

Sharon Gabison, BSc
Research Assistant / Physiotherapist

Shoshana Teitelman, BSc
Administrative Assistant

Sonja Molfenter, MSc
Research Associate

Stephanie Smith, BSc (Hons)
Research Technician

Steven Pong, MDes
Industrial Designer

Sue Woodard
Research Secretary

Susan Gorski, MHSc, PEng
Research Associate

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Physiotherapist

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Central Recruiter

Vanessa Daisy, BSc, RPSGT
Sleep Technician

Vera Zivanovic, MD
Research Coordinator

Veronique Boscart, RN, PhD
Research Coordinator

Yue Li, PhD
Research Associate

Zina Bezruk
Research Secretary

Graduate Students

Primary Supervisor

University of Toronto Department or Institute (unless otherwise stated)
Graduate Research Student: Degree completed, (Degree) in progress

Angus, Jan

Lawrence S. Bloomberg Faculty of Nursing
Craig Dale (PhD)
Marnie Kramer-Kile (PhD)

Black, Sandra/Eric Roy

Graduate Department of Rehabilitation Science
Vessela Stamenova (PhD)

Bradley, Douglas

Institute of Biomaterials and Biomedical Engineering
Hisham Alshaer (PhD)

Bressmann, Tim

Department of Speech-Language Pathology
Janette Quintero (MSc)
Kyle Stevens (MSc)

Brooks, Dina

Graduate Department of Rehabilitation Science
Kerseiri Nadoo (MSc)
Susan Marzolini (PhD)

Cameron, Jill

Graduate Department of Rehabilitation Science
Amanda Marsella, MSc

Carnahan, Heather

Institute of Biomaterials and Biomedical Engineering
Camille Williams, MHSC

Institute of Medical Science
Ryan Brydges (PhD)

Ontario Institute for Studies in Education
Catharine Walsh (MEd)
Maya Sardesai (MEd)
Oleg Safir (MEd)
Samim Al Quadhi (MEd)

Chau, Tom

Department of Electrical and Computer Engineering
Justin Chan (MAsc)
Natasha Alves (PhD)
Sarah Power (PhD)

Graduate Department of Rehabilitation Science and
Institute of Biomaterials and Biomedical Engineering
Andrea McCarthy (MSc)
Denine Ellis (MSc)
Heidi Schwellinus (PhD)

Institute of Biomaterials and Biomedical Engineering

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Negar Memarian (PhD)
Saba Moghimi (PhD)
Stefanie Blain (PhD)

Department of Mechanical and Industrial Engineering
Alex Posatskiy (MAsc)

Cleghorn, Bill

Department of Mechanical and Industrial Engineering
Alex Furse (MHSc)

Colantonio, Angela

Graduate Department of Rehabilitation Science
Veronica Law (MSc)
Catherine Wiseman-Hakes (PhD)
Hwan Kim (PhD)
Robert Balogh (PhD)

Colantonio, Angela / Comper, Paul

Graduate Department of Rehabilitation Science
Michael Hutchison (PhD)

Cott, Cheryl

Graduate Department of Rehabilitation Science
Laura Moll (PhD)

Doan, Helen

Department of Psychology, York University
Gail Kunkel (PhD)

Ferber, Susanne

Department of Psychology
Maha Adamo, MA (PhD)
Stephen Emrich, MA (PhD)
Kristin Wilson (MA)

Fernie, Geoff

Department of Mechanical and Industrial Engineering
Emily King (PhD)
Jennifer Hsu (PhD)

Graduate Department of Rehabilitation Science
Rosalie Wang (PhD)

Institute of Biomaterials and Biomedical Engineering
Mohammad Baharvandy, MAsc
Larry Crichlow (MAsc)
Kaveh Momen (PhD)
Tilak Dutta (PhD)

Flint, Alastair

Institute of Medical Science
Peter Giacobbe (MSc)

Graduate students

Primary Supervisor

University of Toronto Department or Institute (unless otherwise stated)

Graduate Research Student: Degree completed, (Degree) in progress

Gage, William

School of Kinesiology and Health Science, York University

Amy Underhill (MSc)
Martin Vergara, MSc (PhD)
Dmitry Verniba (MSc)
Jeevaka Kiriella (MSc)
Brian Street (PhD)
Nicole Dinn (PhD)

Giangregorio, Lora

Department of Kinesiology, University of Waterloo

Julia Totosy, MSc
Jenna Johnson, MSc
Kayla Hummel (MSc)

Grace, Sherry L.

School of Kinesiology and Health Science, York University

Shamila Shanmuga (PhD)
Shannon Gravely-Wi (PhD)
Yvonne Leung (PhD)

Green, Robin

Department of Psychology, York University

Alexandra Oatley (PhD)

Graduate Department of Rehabilitation Science

April Lee Arundine, MA
Ephram Pano (PhD)
Joanna Glazer, MSc (PhD)

Department of Psychology, Ryerson University

Ronak Patel (MSc)

Jaglal, Susan

Department of Health Policy, Management & Evaluation

Chamila Adhihetty, MSc
Sara Guilcher (PhD)
Sarah Munce (PhD)

Keightley, Michelle

Department of Occupational Science and

Occupational Therapy

Nick Reed (PhD)
Stephanie Green (PhD)

Graduate Department of Rehabilitation Science

Sabrina Agnihotri (MSc)

Lanctôt, Krista

Department of Pharmacology

Yekta Dowlati (MSc)
Walter Swardfager (PhD)

Levine, Brian

Department of Psychology

Nadine Richard (PhD)

Maki, Brian

Institute of Medical Science

Kenneth Cheng (PhD)

McGilton, Kathy

Lawrence S. Bloomberg Faculty of Nursing

Veronique Boscart, PhD
Rola Moghabghab (PhD)

McIlroy, William

Department of Kinesiology, University of Waterloo

Ida Cavaliere (MSc)
Gerald Sung (MSc)

Graduate Department of Rehabilitation Science

Bimal Lakhani, MSc
Ken Tang, MSc
Peter Glazer (PhD)
Sanjay Prajapati, MSc
James Tung, PhD

Kara Patterson, PhD

Ivan Solano (PhD)
Mike Sage (PhD)

Institute of Medical Science

Ada Tang, PhD

Mihailidis, Alex

Department of Computer Science

Michael Tsang (PhD)

Institute of Biomaterials and Biomedical Engineering

Elaine Lu (MSc)

Nagai, Mary K.

Institute of Biomaterials and Biomedical Engineering

Steve McGie (PhD)

Naglie, Gary

Department of Health Policy, Management & Evaluation

Oana Predescu (MSc)

Perry, Stephen

Department of Kinesiology & Physical Education,

Wilfrid Laurier University

Jessica Berrigan (MSc)
Justin Silverman (MSc)

Graduate Department of Rehabilitation Science

Amanda Chisholm (PhD)

Pichora-Fuller, Kathy

Department of Psychology

Katherine Dupuis, PhD
Gurjit Singh (PhD)
Huiwen Goy (PhD)
Payam Ezzatian (PhD)

Popovic, Milos

Institute of Biomaterials and Biomedical Engineering

John Tan (MSc)
Robart Babon Pilipos (MSc)
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Department of Kinesiology, University of Waterloo

Alison Smith, PhD

Steele, Catriona

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Nicholas Lorentz (MSc)
Patricia Hernandez (MSc)

Thomas, Scott

Graduate Department of Exercise Science

Shazareen Khan (MSc)

Graduate Department of Rehabilitation Science

Pearl Yang (PhD)

van Lieshout, Pascal

Department of Speech-Language Pathology

Anneke Slis (PhD)
Heidi Diepstra, MEd (PhD)

Department of Psychology, UTM

Hui Wen Goy (PhD)

Verrier, Molly

Graduate Department of Rehabilitation Science

Kristina Guy (MSc)
Andresa Marhino (PhD)
Sukvinder Kalsi-Ryan (PhD)

Department of Physiology

Meridith Kuipers (MSc)

Wodchis, Walter

Department of Health Policy, Management & Evaluation

Chelsea Hellings (MA)
Chen Wu (MA)
Laura Quigley (MA)
Shannon Reynolds (MA)
Dina Franchi (PhD)
Gavin Wardle (PhD)
Gustavo Mery (PhD)

Zabjek, Karl

Graduate Department of Rehabilitation Science

Justin Chee (MSc)

Editor Margaret Polanyi | Design David Wyman, Wyman Design | Lead Photography Mark Ridout Photography

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