Welcome back to IQ. It’s hard to believe it’s the summer of 2014. Where does the time go? That’s a question we all seem to hear more and more these days. Time certainly is marching on and, subsequently, there’s a significant shift in Canada’s demographics. A quick snapshot shows us that seniors now make up the fastest-growing age group in the country, a trend that is expected to continue for several decades. A couple of years ago, there were an estimated five million Canadians over 65. By 2036, that number is expected to more than double, with some 10.4 million seniors, and 25 years later, it’s estimated that one in four Canadians is expected to be over 65.

So what, exactly, does it mean for this demographic, our health and social systems?

McMaster researchers are doing their part to ensure we all have the chance to live well longer.

Aging is a key strategic area of research for us and stems directly from our established strengths across our Faculties, as well as our interdisciplinary research centres, facilities and initiatives, such as the Gilbrea Centre for Studies in Aging, the Canadian Longitudinal Study on Aging, the Labarge Optimal Aging Initiative, and our new McMaster Institute of Geroscience.

Our success in this area is, in large part, a result of how our researchers look at things. They look at the challenges and the opportunities, from every angle and from virtually every discipline. They blend science expertise with social insights, engineering acumen with medical advances, all in an effort to create new processes, tools, products, treatments, and policies. And their work is making a difference, a difference from which we all will benefit.

Enjoy their stories and here’s to the Golden Years.

Mo Elbestawi
Vice-President, Research & International Affairs

On the cover: Parminder Raina, Canada Research Chair in Geroscience and principal investigator of the Canadian Longitudinal Study on Aging (CLSA), checks out one of the 31 cryofreezers housed in the Biorepository and Bioanalysis Centre located at CLSA’s headquarters at the McMaster Innovation Park.

INQUIRE

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What if your family doctor could detect the earliest signs of dementia and Alzheimer’s disease long before symptoms occur? Then write a prescription that would prevent or delay the onset?

Jennifer Heisz believes that day is not far off. And she’s betting that the prescription won’t be for drugs, but for an exercise regime designed to target a recipient’s specific cognitive deficits.

An assistant professor of kinesiology at McMaster, Heisz believes exercise is one of the most economical ways we can control the rate of decline in our health as we age. But while there is evidence that exercise improves our physical wellbeing, we know little about its direct effects on cognition.

“Studies have shown that healthy seniors who walk more than three times a week have a reduced risk of becoming cognitively impaired, but which aspects of cognition benefit in what ways and to what degree we just don’t know.”

We also know little about the effects of different types of exercise on various aspects of cognition.

What we do know, says Heisz, is that for an exercise program to be most effective, it needs to be implemented at a time when it can produce the greatest change. “Alzheimer’s disease is a very slowly progressing disease that can begin to damage the brain decades before any behavioral symptoms appear. It gives us a window of opportunity for early detection and intervention.”

Her Neurophysiology of Fitness Lab aims to take advantage of that opportunity. With $100,000 from the Canada Foundation for Innovation’s John R. Evans Leaders Fund, Heisz and her team will use electroencephalography (EEG) to monitor the brain waves of about 100 individuals at different points in time over the course of several years.

Participants will be drawn from community members who attend programs at McMaster’s Physical Activity Centre of Excellence (PACE), a ‘living lab’ for state-of-the-art exercise and research training.

Heisz says the goal is twofold. “We want to identify neural biomarkers of cognitive decline so that we can intervene with exercise at a time when it’s most effective. And we want to prescribe the right kind of exercise that will work to improve cognition for that specific individual.”

There are a lot of tests that purport to measure cognitive ability, but they are just behavioral markers, says Heisz. Even with deteriorating cognition, people can still maintain a high degree of function, and may be able to fool the testers into thinking they are fine.

“EEG provides us with a direct measure of brain activity. It lets us see how the brain is working at its most fundamental level.”

Our cognitive ability will inevitably decline with aging, she says, but we can control the rate of that decline through exercise.

“Understanding how exercise improves cognition and how to detect cognitive decline at its earliest stages will allow us to intervene with exercise earlier to slow that decline.”

With the support from CFI, and a newly awarded grant from the Alzheimer Society of Hamilton and Halton, Heisz hopes to develop the first ever exercise guidelines for brain health, as well as early screening tools to detect the first signs of dementia and Alzheimer’s.

“She envisions a future where routine physical exams would include an EEG that can screen for potential neural decline and accurately prescribe an exercise program targeted to a patient’s particular cognitive deficits.

“Older adults do not all have the same experience,” she notes. Some have an inability to focus; others may find it more difficult to remember a person’s name.

“If we know which aspects different exercises target, we can ramp them up to improve those cognitive functions.”

And that will keep us all living healthier and independently for longer. Says Heisz: “It’s not about adding years to our lives, it’s about adding life to our years.”

Jennifer Heisz talks about her work at a recent Canada Foundation for Innovation funding announcement

The best prescription: exercise

JENNIFER HEISZ
Exercise may be the real fountain of youth

Mark Tarnopolsky examines a patient

North Americans spend more than $20 billion annually trying to reverse the march of time. But wrinkle-reducing creams and Botox injections are no match for what a McMaster professor of pediatrics and medicine says is the real fountain of youth – exercise.

Mark Tarnopolsky has found that exercise has the ability to prevent – and even reverse – the aging process in virtually every organ of our bodies, including the skin. And the benefits are dramatic – 65-year-olds who had never exercised before had skin as youthful as someone in their 20s or 30s just three months into a regular exercise regimen.

The groundbreaking findings, presented in April at the annual meeting of the American Medical Society for Sports Medicine, build on earlier studies Tarnopolsky conducted on mice bred to age prematurely. Split into two groups, the rodents with access to exercise wheels maintained healthy brains, hearts, muscles and reproductive organs. Their skin appeared similar to that of younger mice, and their fur did not turn grey. Those without wheels rapidly grew wizened, frail, ill, demented, and graying or bald.

“The active mice had nearly 100% protection from the effects of aging. It was shocking,” recalls Tarnopolsky, who holds the McMaster Children’s Hospital/Hamilton Health Sciences Chair in Neuromuscular Disorders.

He and his colleagues decided to see what would happen in humans. They studied more than 70 male and female volunteers – half sedentary, half well-trained endurance athletes – ranging in age from 20 to 84. A second study looked at 31 men and women over the age of 65 who started a three-month program of cycling 30-45 minutes twice a week.

Exercising skin biopsies taken from the participants’ buttocks – to rule out the effects of any skin damage from sun exposure – researchers found the active people had healthier skin.

“As we age, the middle collagen layer called the dermis thickens and the outer layer of our skin thins,” says Tarnopolsky. “We saw just the opposite in the skin of those who exercised. The dermis was thicker and the outer layer was thinner, like the skin of someone in their 20s or 30s, even in participants aged 65 and older.”

It’s the latest in a long line of studies he has conducted that demonstrate the benefits of exercise – both endurance and resistance training – in lowering the risk of chronic diseases and extending life expectancy.

The first, in 2003, showed significant strength and functional benefits for participants over the age of 65 who completed just 14 weeks of weight training. A 2005 study showed a dramatic boost in antioxidant defenses (and a corresponding decrease in the production of harmful free radicals) in men aged 71 to 78 after four to six months of resistance training.

Other studies support his contention that exercise prolongs life: The Cooper Institute in Texas found regular exercisers had lower rates of heart disease and cancer, while a Stanford study tracked 500 older runners against a similar group of non-runners for more than 20 years. By the end of the study, 15% of the runners had died compared with 34% of the non-runners.

“We can now safely predict that those who exercise regularly will have a 4-6 year life span extension over those who don’t,” says Tarnopolsky.

How does exercise work its magic? The clue, he says, lies in our body’s cells.

We know that with aging comes muscle loss (about one per cent every year) due to a decrease in mitochondria, small structures inside the cells which create 90 per cent of the body’s energy. This loss of skeletal muscle is a risk factor for a range of age-related diseases, including cancer, cardiovascular disease, Alzheimer’s and Parkinson’s disease.

Exercising causes the muscles to release a variety of proteins, which work in a hormone-like fashion to remove damaged (bad) mitochondria and allow new (good) mitochondria to come in. “It’s like pruning a tree. It allows us to remove the cellular junk and rebuild,” says Tarnopolsky, who has coined the term “exerkines” to describe the proteins.

He’s now working to find a way to genetically engineer cells to mimic the effects of exercise in people with mitochondrial disease and those who are prevented from exercising due to severe neurological disorders or muscle loss caused by long periods of inactivity, such as coma.

“We have identified two compounds that work very well. When one of these was injected in mice in incredibly low doses, it provided 70% of the benefits derived from exercise.” It also improved insulin sensitivity, which is promising news for people who are obese or diabetic.

One day, we may be able to pop an exercise pill instead of working out. But Tarnopolsky, himself a competitive endurance athlete, is skeptical that any pill could mimic all the health promoting effects of exercise.

“A half hour daily of moderate activity – brisk walking, jogging, cycling or swimming – is all you need to reap the benefits.”
Teaching an old brain new tricks

PATRICK BENNETT and ALLISON SEKULER

We know our vision deteriorates as we age, but the future may not be as dim as we think.

McMaster researchers have found that aging actually improves certain visual abilities, and in those where it doesn’t, it may be possible to reverse the effects with practice.

Patrick Bennett and Allison Sekuler, professors of psychology, neuroscience & behaviour, are studying the effects of aging on vision as co-directors of McMaster’s Vision and Cognitive Neuroscience Lab. Their work is funded by the Canadian Institutes of Health Research (CIHR), the Natural Sciences and Engineering Council of Canada (NSERC) and the Canada Foundation for Innovation (CFI).

“We know that the brain-body relationship changes as we age,” says Sekuler, who held the first Canada Research Chair in Cognitive Neuroscience. “It affects not just our visual acuity, but the way we see patterns, faces and objects.”

Older people, for instance, find it harder to concentrate on one thing while ignoring everything else. “This works to their disadvantage when they’re trying to follow a conversation in a noisy restaurant, but it can be useful when trying to grasp the larger picture,” says Bennett, McMaster’s Canada Research Chair in Vision Science.

To test this theory, the researchers monitored groups of younger and older people to see how quickly they could determine the direction of bars moving across a computer screen. The younger group performed better when the bars were small and low in contrast (light gray vs. dark gray). When the bars were large and high in contrast (black vs. white), the older subjects did better.

The reason, they think, lies in our neurons. As we age, the inhibitory neurons – which make us better able to detect small objects in a larger background (the larger bars, for instance) – become less efficient.

“It’s actually a visual processing deficit that makes older people perform better on this task,” says Sekuler. “On most standard clinical tests, older people do much worse than younger people.”

“We know that the brain-body relationship changes as we age. It affects not just our visual acuity, but the way we see patterns, faces and objects.”

Allison Sekuler

Take your typical eye exam, for example. The Snellen chart displaying rows of letters in decreasing size from top to bottom is a standard test of visual acuity that’s been used by ophthalmologists for more than 150 years.

Older people do poorly on it, and risk losing their driver’s licence as a result, but Sekuler argues the test underestimates the effects of aging on vision and is not an accurate predictor of driving ability.

“In the real world, drivers are not just driving. They’re talking to the passenger next to them, listening to the radio, negotiating turns. A simple eye test can’t predict how well you will do at this.”

What should be measured, say the researchers, is a person’s “useful field of view”. This peripheral vision field shrinks dramatically as we age, growing worse decade by decade, eventually resulting in tunnel vision. But the researchers have found that, with practice, the decline can be reversed.

Using a variant of the Useful Field of View Task developed by Sekuler’s father, a pioneer in the field of aging and vision, Sekuler and Bennett asked people to identify a letter flashed quickly in the middle of a computer screen and, at the same time, localize a spot flashed quickly in the periphery.

The older subjects initially had difficulty, but after two weeks of training, they could manage both tasks simultaneously and do it just as well as the younger subjects. What’s more, the benefits were long-lasting – tested again after three months, the older group performed as well as they did right after training.

Further evidence that you can teach an old brain new tricks comes from a more recent study by the two researchers in which participants were asked to identify a specific face or pattern from a larger group of images. As with the divided attention task, participants had difficulty at the start, but accuracy rates improved steadily with practice. When re-measured on the task a year later using the original images, accuracy rates were still high.

Bennett and Sekuler’s work has shown that the human brain demonstrates tremendous plasticity across the lifespan. “What we don’t yet know is whether older brains are actually rewiring themselves for weaknesses, or they’re just becoming more efficient,” says Bennett.

But their goal is to find out. Using electroencephalography (EEG), they’re getting a first-hand look at what’s happening in the brain when someone is performing a task.

Says Sekuler: “By understanding what is going on in the brain, we may be able to design better assessments and better treatments that will help seniors see better for longer.”
Is 80 the new 60? It will be if Parminder Raina has his way.

A geriatric epidemiologist and Canada Research Chair in Geroscience at McMaster, Raina is leading one of the largest and most comprehensive studies ever done on health and aging. Its aim is to understand the factors that influence how we age and find ways to prevent, slow or cure age-related diseases so we can live healthier for longer.

With Canadians aged 85 and over now the fastest-growing segment of the population, studying how people age is more important than ever before.

“We are undergoing a demographic shift of epic proportions,” says Raina, whose earlier work with the Health Canada-sponsored Canadian Study on Health and Aging explored the prevalence of dementia among Canadian seniors.

“During the next two decades, the number of seniors will double. We now have more centenarians than ever before, and not all of them are senile and functionally dependent. Many live very full lives.”

Understanding how we age, why we each age differently, and what causes disease and disability as we grow older is critical to our ability to develop programs and interventions that will stave off poor health and promote independent and healthy living for as long as possible.

With a national team of more than 160 researchers and collaborators, the CLSA is following 50,000 randomly selected men and women between the ages of 45 and 85 over a 20-year period to learn why some people live longer and others don’t. Major funders of this project are the Canadian Institutes of Health Research (CIHR), the Canada Foundation for Innovation, the Ontario Ministry of Research and Innovation, and other participating provinces.

The McMaster Innovation Park is home to the CLSA national coordinating centre, and one of 11 data collection sites across the country. It’s also where the 340 million anticipated bits of data from blood and urine samples, cognitive and physical assessments, and interviews and questionnaires completed by participants will be sent and stored. Facilities include a state-of-the-art biobank containing 31 cryofreezers and a lab equipped with a high-throughput robotic workstation that can test for biomarkers associated with the aging process, as well as age-related diseases.

More than 38,000 Canadians have been recruited since 2011, and the study will reach its goal of 50,000 participants in 2015. The first wave of data – gleaned from telephone interviews with the
first 20,000 CLSA participants will be released this summer.

The remaining participants will visit a data collection site, first when they sign up for the study, then every three years thereafter. This allows researchers to monitor changing biological, medical, psychological, social, lifestyle and economic aspects of people’s lives.

“We want to know how each aspect – alone and in combination – impacts the health and development of disease and disability as people age,” says Raina.

“Genetics plays a factor, we know, but there are other influences that can put us on one path vs. another. Children leave home, people retire, there's economic gain or loss. Midlife brings all sorts of transitions, especially for women who are undergoing biological changes such as menopause. How do these transitions affect people's health, and how do they adapt? What role do communities, social support, and health systems play? How does living in an urban or rural environment impact the aging process?”

“During the next two decades, the number of seniors will double. We now have more centenarians than ever before, and not all of them are senile and functionally dependent. Many live very full lives.”

It’s a cell-to-society approach that will yield a mine of rich data that can be used by researchers worldwide to examine diseases of the circulatory system, the brain, the musculoskeletal system, respiratory system and endocrine/metabolic systems.

“We know that the changes in our body that come with aging represent a common risk factor for disease,” says Raina, who holds the endowed Labarge Chair in Optimal Aging. He has conducted numerous leading-edge studies on aging and disease prevention.

“What we learn from this could tell us a lot about how chronic inflammation is linked to cancer, heart disease and Alzheimer’s disease; how responses to stress can accelerate aging and risk of disease; how work history and wealth contribute to our health and well-being; and more.”

By taking an integrated approach to the study of disease and disability associated with aging, Raina has advanced the field of geroscience and is breaking down walls...
between disciplines to get gerontologists, geriatricians, biologists, psychologists and others to look at the science of aging from a holistic perspective.

“I started talking to people on campus and found that there were more than 50 faculty members who were working in the area of aging but never said so,” he recalls. He began campaigning for a university-wide virtual institute that would bring them all under one umbrella.

Approved in April by the University’s Board of Governors, the McMaster Institute of Geroscience will be the first of its kind in Canada to bring together interdisciplinary groups of faculty members and postgraduate students to conduct collaborative cutting-edge research on aging.

“There is no other institution better equipped to do this,” argues Raina. “We have the kind of capacity that doesn’t exist anywhere else in Canada. But for us to establish leadership nationally and internationally, we need to create infrastructure like a Big Data Centre, an aging mouse colony and a technology centre that will make us competitive and allow us to attract funding from research agencies.”

The new Institute will be closely linked with another initiative close to Raina’s heart, the McMaster Optimal Aging Portal, a web site dedicated to making the best and most up-to-date research on aging.

Knowing this could have a dramatic effect on the quality of life for those living with two or more chronic conditions. “If you have high blood pressure, heart disease, arthritis and diabetes, you may be taking six or seven different medications. All of them influence the way you function. Maybe we can get rid of some that are not as important as others.”

For Raina, it’s all about giving people the knowledge to make informed decisions. “We want those who need complex care to get the right kind, and those who are living independently to be able to do so for as long as possible. And that’s a very achievable goal.”
Optimal aging at home

MAUREEN MARKLE-REID and JENNY PLOEG

Not all Canadians who are living longer are living well. Nine out of 10 aged 65 and older are afflicted with a combination of illnesses – diabetes, high blood pressure, heart disease, dementia and arthritis, among others – that leave them over-doctored and over-medicated while doing little to improve their overall health and functioning.

It’s a health care crisis of epic proportions, says Maureen Markle-Reid, an associate professor in McMaster’s School of Nursing. “People with multiple chronic conditions (MCC) tend to have poorer health and take more prescription medications, typically five or more a day. They use health care services more frequently and multiple services simultaneously, and have a higher risk of hospitalization, falls and death.”

Markle-Reid, who holds a Canada Research Chair in Aging, Chronic Disease and Health Promotion Interventions, aims to tip the balance by changing the way health services are delivered to this population. Instead of a traditional, ‘silo’ approach focused on a single disease, she and colleague Jenny Ploeg are championing an interprofessional, community framework that maximizes care coordination and involves end users at every step of the way.

Their efforts won them $5.8 million in funding – $2.5 million over five years from the Canadian Institutes of Health Research (CIHR) and $3.3 million over three years from the Ontario Ministry of Health and Long-Term Care – which is being used to support seven interrelated studies as part of a new Aging, Community and Health Research Unit (ACHRU) at McMaster.

“Our overall goal is to promote optimal aging at home for older adults with MCC, and to support their family caregivers,” says Ploeg, a professor in the School of Nursing. Ploeg and Markle-Reid are co-scientific directors of the ACHRU.

The researchers say what is lacking is an integrated approach to health service delivery that leaves this population vulnerable, while racking up costs to our health care system.

“People with MCC may be seeing a number of different specialists – someone for diabetes, another for heart disease, and so on – but there is no overall strategy or communication between them,” says Ploeg.

With a team of 30 investigators and more than 25 partners across Canada, from multiple disciplines, the ACHRU is designing and testing community-based interventions aimed at preventing or better managing MCC. Studies focus on Type 2 diabetes, dementia and stroke in the context of other chronic health conditions.

One study has created a mobile health app that allows home care professionals to communicate in real time with nurse care managers or primary physicians. When a patient falls, for instance, those professionals can be alerted. A best-practice checklist embedded in the app tells caregivers what they can do to prevent further falls. Another feature allows them to track the number and frequency of falls in a given period so they can monitor the patient’s health over time.

The app will be as part of a study that will evaluate an innovative, community-based rehabilitation program for stroke survivors, says Markle-Reid. “By recording assessments and including best-practice checklists on a range of issues, homecare workers should be able to see the whole picture – the physical, social and emotional needs of a patient – and make better decisions.”

Another study is evaluating an online toolkit designed to ease the burden on family members caring for individuals with Alzheimer’s disease. In a third study, researchers are experimenting with novel ways to encourage diabetics to take better care of their own health, including moving diabetes services to a seniors’ centre, where patients get exercise and nutritional information along with a meal and social interaction.

“A key part of the research,” says Markle-Reid, “is talking to the end users. We really don’t know what they’re going through.”

To find out, patients and family caregivers are invited twice a year to meetings where they can voice their experiences to community agencies, health system decision makers and policymakers, and offer potential solutions.

This kind of broad participation is important, says Ploeg. “Older adults are rarely included in decision-making processes around their illnesses. They tend to follow the lead of physicians and other professionals, especially when it comes to decisions around medication. For our research to have a lasting impact on practice and policy, we need to make sure it’s relevant.”

It’s an approach that comes naturally to the two nurses, who spent many years working with older adults in the community, Ploeg as a public health nurse, and Markle-Reid in home care and hospital settings.

“Nurses know, better than most, how to navigate the health system,” observes Markle-Reid. “This is critical if we are to serve the needs of this growing population and their families.”
The cost of caregiving

ALLISON WILLIAMS

It’s no secret that our rapidly aging population has precipitated a soaring rise in the number of people suffering from chronic diseases. What’s surprising is that their loved ones may be suffering the most.

Four in 10 Canadians have a family member who suffers from a chronic illness. The vast majority are cared for at home. The physical, emotional and economic costs of being a caregiver are high. And it’s women who are bearing the brunt of it all.

Allison Williams has spent 15 years studying the issues around caregiver burden, especially the economic costs and health risks faced by caregivers who are also employed.

“Canadian workplaces are faced with the challenge of managing a workforce which is, due to health care restructuring, increasingly expected to provide unpaid caregiving to family members,” says the McMaster professor of geography who holds a Canadian Institutes of Health (CIHR) Chair in Gender, Work and Health. “The strain felt by caregiver-employees is very real. It impacts employers, the health care system and society as a whole.”

Canada’s Compassionate Care Benefit, introduced in 2004, was supposed to help, by providing up to eight weeks leave for a full-time employee caring for a terminally ill family member. But a 2010 evaluation of the program led by Williams found huge gaps in the service. Eligibility requirements are stiff: Only full-time employees are eligible yet they make up less than a quarter of informal caregivers; employees must meet a minimum threshold of weekly hours worked, a policy that excludes many temporary, seasonal and part-time workers; the level of compensation, and the support period, is limited; and, perhaps the biggest affront to users, caregivers must produce a doctor’s certificate saying the person they’re caring for is likely to die within six months.

Williams says workplaces need to do a better job of accommodating employees who act as caregivers at home. “Most are older women trying to sustain a full-time job while caring for spouses who are even older. Many end up going to part-time or casual/temporary jobs, or leave the workforce altogether.”

“We need to develop sex and gender sensitive policies and interventions that ease the strain between the work they do as caregivers and their role as paid workers.”

She is currently developing a web-based decision-making tool that helps caregivers with jobs find better ways to manage their dual responsibilities so they can stay healthy, both emotionally and physically.

“Caregivers typically put the needs of the care recipient ahead of their own,” says Williams. “This is a hands-on tool that allows them to step back and look at the situation objectively. They input information about their employment (such as job description, seniority, number of hours, income, benefits) and their caregiving (tasks, number of hours, etc.), and receive strategies they can use to start a dialogue with their employer.”

Solutions, she says, can be as simple as obtaining a parking spot close to the exit door of one’s workplace, or changing work start and end times. The next step, says Williams, is to find an employer willing to work with her to design effective interventions for their own caregiver-employees.

Interest is high, she says. “Businesses, especially the larger ones, know caregiving has very clear impacts on employee health and disability benefits. They recognize the importance of recruiting and retaining good employees. The goal is to address this issue early on with workplace wellness strategies and interventions that keep their employees healthy and productive.”

A second project will examine the situation of caregiver-employees who are most vulnerable. “These are people working from pay cheque to pay cheque, whose jobs and health are most at risk,” says Williams. “We will follow them, determine what directions they take, how and if they manage, how their life changes, and what they can do to empower themselves.”

Another study, jointly funded by the Ontario Ministry of Health and Long-Term Care and CIHR, is looking at family caregivers of adults aged 65 and older who have dementia, heart disease or diabetes plus two other chronic conditions, such as arthritis, poor eyesight or a skin condition.

The information will be used to develop community-based primary health care strategies to assist this unique and growing group of caregivers, who have so much to give but so much to lose.

Says Williams: “This is an issue that is not going to go away. The number of working women in North America is the highest it has ever been. We can’t afford to lose them. We need to develop sex and gender sensitive policies and interventions that ease the strain between the work they do as caregivers and their role as paid workers.”
For today’s baby boomers, who grew up in the ‘50s, learning to drive was a rite of passage, a badge of freedom they worked hard to earn. But many could be forced to give up their driver’s licences as they age, with devastating costs to their health and well-being.

“Driving a car is an integral part of our identity,” says Brenda Vrkljan, an occupational therapist and associate professor in McMaster’s School of Rehabilitation Science. “Take that away and the messaging is that you are no longer competent.”

Vrkljan is convinced it doesn’t have to be this way, and her research is proving that with sensitivity and creativity older Canadians can be safe drivers, too.

As lead investigator for one of six teams tracking more than 1,000 Canadian drivers over the age of 70, she uses GPS to monitor their driving habits and identify key factors that impact their performance behind the wheel. The Canadian Institutes for Health Research (CIHR)-funded initiative is called Candrive (Canadian Driving Research Initiative for Vehicular Safety in the Elderly), and it’s the first of its kind in the world. The study now has sister sites in Australia and New Zealand (OzCandrive).

She knew going in that the statistics are not in favor of older drivers. While the overall number of collisions goes down as people age, crashes per mile driven go up at age 70. Older people are also more likely to be injured in a crash due to frailty, and have a more difficult time recovering.

But Vrkljan learned something else that was eye-opening. When seniors were asked to describe their driving abilities, those who perceived them as weak or confessed to having a lower comfort level with driving were experiencing significant changes in their health status that could increase their risk of a collision.

“Ontario has just introduced a new screening approach for older drivers that measures their cognitive ability, which is critical to ability behind the wheel,” she says.

But it’s only one measure of driving ability. “Driving is a complex task that requires a combination of skills. Evaluating this task requires a comprehensive, evidence-based approach.”

The Candrive team is now working to develop a battery of tools that would assess everything from an individual’s medical history and the impact of medications they’re taking to their vision, hearing, strength, range of motion, and how they manage the activities of daily living. The result, she hopes, will be a simple, scientifically-validated process that health professionals Canada-wide can use to determine whether person should be allowed to continue driving.

And if it means more older Canadians will be driving longer, why not improve the driving environment for them?

A second research project is working to do just that. With funding from AUTO21, a national automotive research network, Vrkljan and her team have installed cameras in the cars of Candrive participants allowing for real-time monitoring of their driving behaviors.

“How do they hold on to the steering wheel? How do they position themselves in the car? The answers to these questions will allow auto makers to understand the user experience and improve vehicle design to enhance the safety and comfort of this fast-growing market segment.”

Vrkljan is now collaborating with Robert Fleisig, assistant professor of mechanical engineering at McMaster, to focus in on the needs of older drivers with mobility issues.

With a grant from the Labarge Optimal Aging Opportunities Fund, established by McMaster Chancellor Suzanne Labarge, the researchers will combine data from laboratory testing and ride-alongs in the community to learn how these drivers enter and exit the car and where they place their cane or walker. Additional funding from the Canada Foundation for Innovation will allow them to build the infrastructure they need to design vehicle changes that can be tested with older drivers using life-size prototypes developed by an advanced 3D printer.

Vrkljan says it’s just the beginning. “There are so many opportunities to improve how we age in place – the way we design cars, gas stations, even door levers and faucets in our homes. Things don’t have to be the way they are. I’m convinced we can do better.”
“Accelerated aging” has become a very real threat in our increasingly sedentary society. Studies have shown that only 15% of Canadians achieve the minimum amount of daily recommended exercise, and one in four Canadian adults is obese. “Obesity is a huge factor in age-onset diseases,” says Greg Steinberg, an associate professor in McMaster’s Michael G. DeGroote School of Medicine. “We used to see people developing diabetes and cardiovascular disease in their 60s and 70s. We’re now seeing the same conditions in people in their late 20s.”

When the cells of your body are hungry, they burn fat to survive. But what makes them hungry? Exercise and calorie restriction, not surprisingly, both work to activate AMPK. So does resveratrol, an ingredient found at low concentrations in red wine.

Putting the brakes on accelerated aging

Greg Steinberg

“Obesity is a huge factor in age-onset diseases. We used to see people developing diabetes and cardiovascular disease in their 60s and 70s. We’re now seeing the same conditions in people in their late 20s.”

More recently, Steinberg’s research has uncovered links between increased AMPK activity and two commonly used drugs associated with increased longevity. One is aspirin, long known to increase longevity by reducing the risk of heart attack and stroke, thanks in part to research done at McMaster in the 1960s. Working with colleagues in Canada, Scotland and Australia, Steinberg discovered that salicylate, the active ingredient in aspirin, activates AMPK to increase fat burning and decrease liver fat in obese mice.

And just last year, Steinberg solved the mystery of how metformin, a popular drug taken by more than 120 million Type 2 diabetes sufferers, actually works. Turns out it also activates AMPK, which in turn reduces harmful fat molecules in the liver, allowing insulin to work better to lower blood sugar levels.

Most people taking metformin have a fatty liver, frequently caused by obesity. “This causes their blood sugar to go up because insulin can’t work as efficiently to stop blood sugar coming from the liver,” says Steinberg.

All roads lead to Rome, it seems. Salsalate, a well-tolerated aspirin derivative, is now being tested to see whether it can prevent Type 2 diabetes. And a slew of metformin studies have the one-time diabetes medication being hailed as a wonder drug that may be just as effective at combatting lung, breast and prostate cancers.

Steinberg’s goal is to find new ways to use these and other well-tolerated therapies to target aging. As co-director of the Metabolism and Childhood (MAC-Obesity) Research Program, he is also intent on understanding the role that nutrition and exercise play in maintaining good health across the lifespan.

“When you think of it, the aging process actually begins at the prenatal stage. We need to be looking at how we can prevent aging and promote healthy aging at every stage of life. Physical activity and nutrition are crucial.”

His work is being funded by grants from the Canadian Institutes of Health Research (CIHR), the Natural Sciences and Engineering Research Council (NSERC), the Ontario Research Fund Research Infrastructure (ORF-RD) program and the Canadian Diabetes Association. He is also collaborating with biotech companies who are conducting AMPK research.

His hope is that we will be able to push back the ‘accelerated aging’ start button. “We can’t stop time, but we can work to keep people as healthy as possible for as long as possible.”
Diversity in aging

AMANDA GRENIER

Advances in biomedical science are helping many people live longer and healthier lives than ever before. But does that equate with aging well?

Researchers at McMaster’s Gilbrea Centre for Studies in Aging have found that housing, transportation, social inclusion and socioeconomic status can have just as great an impact on a person’s ability to age successfully.

Their work is challenging some long-held assumptions about aging and late life, and generating new ways of thinking that could influence social policy and community planning efforts to better meet the needs of older people.

“Most people view old age chronologically. You hit a certain age and you’re old,” says Amanda Grenier, director of the Centre and a leading researcher in the emerging field of critical gerontology. “This approach has led to social and economic policies being tied to age. But is it really about age or is it about functional impairment, cognitive impairment, or other social issues that can impact life trajectories?”

Critical gerontologists argue that the major problems older people face have less to do with their chronological age and more to do with things like poverty, access to services and social exclusion.

“Perceptions, life events and experiences influence how people age,” says Grenier, an associate professor of health, aging and society who holds the Gilbrea Chair in Aging and Mental Health at McMaster. “Someone who is injured on the job and forced to retire may have a very different retirement experience than someone who can make a choice around whether or not to stay working.”

The Gilbrea Centre is a hub for researchers in the faculties of Social Sciences, Health Sciences and Science who are bridging interdisciplinary perspectives to better understand aging within a contemporary context. Their study of the socio-cultural issues around aging – social networks and social support, paid and unpaid work, retirement, socioeconomic status, environment and mobility – and how these issues impact individuals, communities and societies is advancing the critical discourse on gerontology and shedding new light on what it means to grow old.

“We have a tendency to think all older people are the same, but we have to look at the various types of diversity in aging,” says Grenier. “It’s about the older immigrant, the person with dementia, the older person living in poverty. We have to rethink the policies and programs we are delivering to older people so that they better fit what people are experiencing as they age.”

How should we think about and plan for retirement? How can we better support family caregivers? What are the social implications of living with dementia? How do we meet the needs of older immigrants or older people living in poverty? How do we build age-friendly communities?

“We examine new and cutting-edge research questions that are relevant to future planning,” says Grenier. The Centre’s work is having such an impact that the Canadian Association for Gerontology chose it as the host organization for its next international conference to be held this fall.

“It’s testament to what we’ve achieved in a very short time, but also to McMaster’s long tradition of excellence in the study of gerontology and health and human aging,” notes Grenier.

The Centre has become an innovative forum for practitioners and researchers to share information and learn from each other – knowledge transfer that links research to practice. Its outreach efforts include Seniors Helping Advance Research Excellence (SHARE), a bank of some 400 senior volunteers from the surrounding community. They complete questionnaires and surveys for student research projects, participate in lectures, seminars and a reading group, and even conduct tutorials for students, ensuring the bridge between campus and community stays strong.

Grenier’s own research includes subjective interpretations of aging and late life. She has conducted hundreds of interviews with older people to capture their personal stories around late life transitions, impairment, and ‘frailty’, and continues to explore how these narratives can inform contemporary planning efforts.

Her latest interviews, part of a groundbreaking three-year study of aging and homelessness, have been conducted on the streets of downtown Montreal. What she’s learned has been eye-opening.

“A common assumption is that elderly people living on the street have been homeless for years. We’ve found that many became homeless after they were old. This is an important distinction if you’re a policymaker charged with forging a nationwide agenda on homelessness among older people.”

Insists Grenier: “Understanding the lived experiences of older people is essential if we are to move beyond stereotypes around aging and ensure that policies and programs address the reality of what older people are facing.”

How do we meet the needs of older immigrants or older people living in poverty?

How should we think about and plan for retirement?

How can we better support family caregivers?

How do we build age-friendly communities?

What are the social implications of living with dementia?
For elderly people living alone, going to the toilet may soon involve more than eliminating just waste. It could eliminate the guesswork involved in managing their day-to-day health, reminding them to take their medication and telling them when to seek medical attention.

A sensor-equipped toilet is just one feature being incorporated into a “smart” home that will develop and test new sensor technologies capable of monitoring a myriad of health indicators for elderly people living with chronic conditions.

The 1,600-square-foot bungalow, to be built this year, will be the centerpiece of a new Technology Development Park for Healthy Aging at the McMaster Innovation Park. The brainchild of three McMaster engineering professors, it will be the first residential facility in Canada to have tiny sensors mounted on walls, in the toilet, in kitchen appliances, even on clothing. The sensors will help elderly people avert falls and improve their sleep, while alerting health professionals to a host of conditions – from Alzheimer’s disease and diabetes to heart attack or liver problems – long before symptoms occur.

For Qiyin Fang, who holds a Canada Research Chair in Biophotonics, it’s as much personal as it is scientific. His grandfather, now over 100 years old, still lives in his own home.

“Medications need to be monitored closely. If directions are not followed, a minor issue can become a serious problem, and he could end up in the emergency room. It’s a source of anxiety for the entire family.”

Fang was involved in a previous project that used sensors to detect water quality problems, collaborating with Ravi Selvaganapathy, Canada Research Chair in Biomicrofluidics, and Jamal Deen, Canada Research Chair in Information Technology. Deen had led a “smart medical apartment” research and technology development initiative as a distinguished visiting professor in South Korea, and all three worked with clinicians at Hamilton’s Juravinski Cancer Centre, where nurses regularly phoned patients to make sure they were taking their medications.

“We thought, what if we could put a system in place that would not require any user expertise,” says Selvaganapathy.

“If we could continuously and remotely monitor a person’s physical activity and physiological changes, and do the type of analysis normally done in a lab – for example, analyzing urine for drugs, glucose levels and other biomarkers – then transfer that information in near-real time back to the patient or the patient’s doctor, we would remove the self-compliance aspect, increase our chances of early detection and intervention, and prevent needless trips to the emergency room.”

The three researchers have combined their expertise in optical sensors and imaging (Fang), electrochemical sensors (Selvaganapathy) and advanced sensors, imagers and information systems (Deen, the lead investigator) to produce an integrated network of customized sensors and imagers – some as small as a human hair. These advanced sensing systems could potentially track an elderly person’s every move, every breath, every drop of sweat and, yes, every pee.

With their collaborators Thia Kirubarajan, Canada Research Chair in Information Fusion, and Ridha Khedri, a computer science specialist in data security, the raw data will be integrated and transmitted to a secure database where it can be picked up by a physician or nurse.

Multisource information fusion is an emerging and active field of research that has gained applications in medicine, transportation, communications and defense, among others. For this project, Kirubarajan and Khedri will develop fusion algorithms that will assimilate multiple sources of information collected by the sensors to assess threats to health and well-being and assist in prognosis and risk management.

The ‘fused’ data can also be made to trigger external stimuli, such as a “smart” bracelet vibration, in direct response to a change in vital signs or heightened risk of falling.

“The sensors act as an early warning system that something is wrong,” explains Deen, who will monitor not just walking speed, but acceleration, sway, orientation,
limbs and torso coordination, such as the way people tilt their legs or synchronize foot and hand movements.

“These are all things that make up what we call a person’s ‘walking age’. People in different age groups walk with certain characteristics, and any deviation in their walking patterns could be an early indicator of the onset of Alzheimer’s disease, other health problems, or deterioration in balance, which may lead to falls.”

Deen is also developing the home’s “smart” sleep system.

“The Smart Home Team

Jamal Deen
Canada Research Chair in Information Technology and professor of electrical and computer engineering

Qiyin Fang
Canada Research Chair in Biophotonics and associate professor of engineering physics.

Ridha Khedri
Data security specialist and professor of computing and software

Thia Kirubarajan
Canada Research Chair in Information Fusion and professor of electrical and computer engineering

Ravi Selvaganathapy
Canada Research Chair in Biomicrofluidics and associate professor of mechanical engineering

“This will be an open research platform that can be used by basic scientists, health professionals interested in clinical outcomes, and companies interested in commercializing these technologies.”

Ravi Selvaganapathy

“Sleep-related problems are common in the elderly,” notes Deen. “They may have trouble falling or staying asleep, and getting enough sleep. They often get up frequently to go to the bathroom. Or the quality of their sleep may be affected by age-onset conditions like Alzheimer’s, chronic disease, and changes in the body’s internal clock, as well as medications or depression.”

To help address these problems, he is developing a sleep management system using environmental sensors and actuators and vital sign sensors. These will be controlled by a central computer system that collects sensed data and results based on a check-up sheet developed by a clinician. The data collected will be used to control the sleeping environment by automatically adjusting the room’s temperature, humidity, oxygen level and lighting to improve the quality of sleep.

“For the first time, we will be able to customize a person’s sleeping environment to their specific needs. Our hope is that it will not only help them sleep better, but it will serve as an early detection system for sleep problems that can impact their overall health.”

Some of the most advanced monitoring will take place in the “smart” toilet, designed by Selvaganapathy. Programmed to recognize the user based on his/her weight, it will record the number and frequency of visits, and test for proteins, chemicals (including medications), ions, uric acid, pH and DNA using a complex system of extraction and electrochemical analysis.

“This type of analysis is typically done in a centralized lab at a cost of hundreds of dollars,” says Selvaganapathy. “We will be able to do it for a dollar a test, and we’ll be able to do a thousand tests all at the same time.”

The researchers are negotiating with local builders to have the home built at no cost, and are looking to the Ontario Research Fund and private funders to help outfit the interior. It will include equipment for microfluidics development, a wet lab for chemical and biological processing, and a suite of sensors and actuators.

Says Selvaganapathy: “This will be an open research platform that can be used by basic scientists, health professionals interested in clinical outcomes, and companies interested in commercializing these technologies.”

And that’s just the beginning. The same technology could be used by farmers to monitor phosphate levels in their soil or by public health officials to track the incidence of disease in real time.

“Getting accurate information as quickly as possible to those who can use it to make critical decisions – that’s what it’s all about.”

— Ravi Selvaganapathy
BUILDING ON OUR STRENGTHS

It’s a place where industry and academic leaders work side by side. Where entrepreneurs, scientists and engineers tackle some of society’s most challenging R&D issues. Where they find solutions. Where ideas are born and leaders of tomorrow are trained. It’s the McMaster Innovation Park in Hamilton, Ontario, a culturally rich and vibrant city with deep roots in manufacturing and healthcare. And it will be the new home of BEAM, a state-of-the-art biomedical engineering and advanced manufacturing research centre focusing on cell therapy manufacturing and diagnostics.

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