

AG NORTH AMERICA ANALYSIS

ADJACENT GOVERNMENT | November 2016

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WELCOME

Welcome to the Adjacent Government – North America Analysis. In this special edition we highlight a number of key features regarding North American countries. Shining light on areas such as healthcare, agriculture, and research, the publication features a number of contributors specifically from Canada and the US.

Focusing on a number of topics within each section, the analysis begins with a Canada focus. The Canada section of the supplement kicks off with a piece from Ted Hewitt, President of the Social Sciences and Humanities Research Council in Canada. It highlights the importance of efforts to internationalise social and humanities research across the Atlantic, and specifically looks at a programme called ‘Digging for Data’, which explores new methods for harnessing ‘big data’. The section also features an article from Ministry for Education in Ontario, which details the importance of ensuring everyone receives education in that region.

Other topics covered in the Canada section include illegal fishing, with an article from the Minister for Fisheries in Canada, the Honourable Dominic Le Blanc. The article from Minister Le Blanc details the devastating effects of illegal and unreported fishing on Canada’s fish stocks. Other articles include an article looking at Canada’s energy policy by Minister of Natural Resources in Canada, James Gordon Carr, and a piece from the Canadian Institutes of Health – Insti-

tute of Neurosciences, Mental Health and Addiction.

As the US gears up for its much debated general election and the people of America decide who they want as their next President, in the USA section of the analysis we cover topics such as research agriculture and neurodegenerative disorders. For example, an interview with Melinda Kelley at the National Institute of Aging, within the National Institutes of Health, highlights the work they do to maintain funding for research into Alzheimer’s disease.

We also look at the work of the National Institute of Food and Agriculture at the US Department of Agriculture, on food safety. The article highlights a number of food safety measures being researched in various organisations and how they are integral in an ever changing climate. Other areas looked at include: water quality; reducing the impact of climate change on agriculture; and physics.

We do hope that you find this North America Analysis interesting and of use. We welcome any comments that you may have.

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Laura Evans
Editor

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Digging into data for research

Canada is proud to co-lead efforts to internationalise social sciences and humanities research across the Atlantic – and back again. Here Ted Hewitt, President of the Social Sciences and Humanities Research Council of Canada explains why to [Adjacent Government](#)...

The social sciences and humanities research environment in Canada has always been a vibrant one. We are fortunate to have a large pool of talented researchers examining critical questions, and constantly exploring unseen avenues through which to innovate and, ultimately, improve the lives of Canadians.

But as the global landscape changes, and new digital research methodologies take hold, Canada is increasingly reaching beyond our borders to advance knowledge. Our interconnected world means that research that was once regionally focused may now be applicable an ocean away.

The [Social Sciences and Humanities Research Council](#) (SSHRC), as a research funding agency of the government of Canada, is in a good position to help mobilise our scientists and academics to make a big contribution to the world. An important foundation has been built through the establishment in 2013 of the [Trans-Atlantic Platform](#) (T-AP). A collaboration between key funders of social sciences and humanities research from the Americas and Europe, T-AP is meant to establish a sustained basis for cooperation and coordination between granting agencies in the social sciences and humanities. The goal is to open doors and remove barriers to international collaboration among researchers.

As co-chair of the EU-funded Trans-Atlantic Platform and president of SSHRC, I am proud of SSHRC's role as co-lead in this partnership. SSHRC is lead for the Americas, and the Netherlands Organisation for Scientific Research serves as the lead for Europe.

A concrete example of what T-AP can accomplish is the [Digging into Data Challenge](#). SSHRC is a key funder of this program. As information and research materials



Ted Hewitt, SSHRC President

increasingly become digitised, the fundamental information that social science and humanities researchers need can get lost in the sheer volume of materials now available.

The question of how best to tap “big data” in search of key insights, and how to develop and apply computer-based tools to help social sciences and humanities researchers access it, has been explored since the competition's inception in 2009. The relationships built through T-AP – now embracing 16 agencies representing 11 countries – have allowed this initiative to be expanded to an impressive array of funders and researchers.

Specifically, the T-AP Digging into Data Challenge offers funding to international teams of researchers to explore new methodologies and techniques for harnessing “big data” to address their research questions. The latest competition closed in June with an unprecedented 109 applications received. Each of these proposals has at least 3 T-AP countries participating. Winners are expected to be announced early in 2017.



Past funding award winners have delved into, and shared knowledge about, accessing and compiling data on a variety of topics. Some examples of winning projects are:

- A study of the 1918 Spanish flu outbreak in the United States and how media shaped public opinion around it;
- An examination of Twitter data to see how words are used by men and women in different regions of the United Kingdom and the United States;
- A project that brought together political scientists from Canada, the Netherlands and the United Kingdom to conduct a large-scale analysis of the proceedings of their countries' respective parliaments from the 1800s to present day to create a dataset to facilitate the study of them.

Building on the success of the Digging into Data project, T-AP aims to develop other international funding opportunities to further the ability of social sciences

and humanities researchers around the world to work together to advance scholarship in key areas of pressing global concern.

Closer to home, our goals at SSHRC are increasingly complementary to those of T-AP. We will continue to invest in developing next-generation researchers throughout Canada's postsecondary institutions who are equipped with the latest research tools. And we will continue to connect decision-makers in all sectors – public, private and not-for-profit – with the evidence-based knowledge that builds strong communities and innovative societies. ■

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Ted Hewitt
President

Social Sciences and Humanities Research Council
of Canada.

www.sshrc-crsh.gc.ca

www.twitter.com/SSHRC_CRSH

The innovation pipeline needs fixing – redefining STEM in Canada

It is time to abandon the innovation pipeline concept and embrace a dynamic model of research and discovery in Canada, says NSERC President Dr. B. Mario Pinto...

Canada – and the world – is on the brink of an exciting future. Science, technology, engineering and mathematics (STEM) can help make sure we get there, but only if we fully mobilise Canada's discovery and innovation ecosystem. Fresh thinking about how innovation works, and how players in the system can work together, is required to solve this challenge. The potential benefits are substantial.

To start, we need to abandon the traditional concept of an innovation pipeline. In this model, innovation occurs in a linear process with a clear division of labour, with discovery and innovation as separate endeavours. With talk about an emerging "Fourth Industrial Revolution", this paradigm does not reflect today's technological reality.

The research and innovation ecosystem has become much more collaborative, interdisciplinary, dynamic and non-hierarchical than before. Consider the dramatic changes in the education and training of students. Students continue to be trained in the art of creative and critical thought. But with this as a foundation, they are now exposed to interdisciplinarity, experiential learning, international experience, and entrepreneurial culture. This modern pedagogy will give them the skills to assess and respond to opportunities and challenges in a rapidly-changing landscape.

If asked, these emerging leaders would firmly reject the idea of an innovation pipeline because it does not reflect the dynamic interplay of discovery, invention and innovation. A different way to think about the relationship between discovery and innovation is as a single loop with numerous entry points and feedback mechanisms. Information flow is bi-directional. Many different players are involved, but they act in a highly integrated and purposeful way.

For example, graphene, a revolutionary nanomaterial 200 times stronger than steel, was the result of discovery research. As is often the case, however, efforts by industry to explore the capabilities of this material and to reduce production costs for market deployment have triggered fundamental new questions that can only be addressed by further discovery efforts. This interplay of discovery and innovation has opened up an astonishing range of potential applications for graphene, from new battery technologies to graphene-reinforced silk.

"In Canada, we need to continue to provide equality of opportunity so that diverse academic institutions can pursue research areas in which they are leaders – areas that match the needs and strengths of their region. These constitute primarily undergraduate institutions, research-intensive universities and colleges or polytechnics."

Awareness of this new model is only the first step; we must find better ways to optimise the system and raise the level of play for both researchers and industry. The current system is too complex and filled with redundancies. It fails to coordinate and leverage our resources, expertise and best practices.

Full mobilisation requires an attitude shift, one that is honest about redundancies, that eliminates them, and that embraces the diversity of expertise to deliver innovation. As NSERC moves ahead with its new strategic plan – NSERC 2020 – we have made it a priority to foster such a system.

We are focused on stimulating R&D&D – research and development and delivery – going the distance to ensure the full delivery of innovation for broader economic and societal gain.



Getting there will require NSERC to more formally pursue a convener role bringing all players together. Currently, we invest heavily so that Canadian researchers can develop world-leading discoveries and ideas. As well, we have programmes to facilitate close connections and partnerships with business to ensure that discovery research is constantly mixing with and enriched by industry and market perspectives.

“To start, we need to abandon the traditional concept of an innovation pipeline. In this model, innovation occurs in a linear process with a clear division of labour, with discovery and innovation as separate endeavours. With talk about an emerging “Fourth Industrial Revolution”, this paradigm does not reflect today’s technological reality.”

Being a convener also means that NSERC programmes must reflect and support greater diversity across business sectors, academic institutions, gender and culture. With diversity, we are more likely to be bold – even audacious – in discovery research, creating

opportunities that those with a more homogenous perspective will miss. In Canada, we need to continue to provide equality of opportunity so that diverse academic institutions can pursue research areas in which they are leaders – areas that match the needs and strengths of their region. These constitute primarily undergraduate institutions, research-intensive universities and colleges or polytechnics.

If we continue to push the frontiers of discovery research and if we embrace innovation with an informed perspective, I am confident that STEM will play a pivotal role in creating a brighter future for all. ■

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Dr. B. Mario Pinto
President

Natural Sciences and Engineering
Research Council of Canada
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Canada's oil and gas sector in a clean energy world

Canada's transition to clean energy is already well under way, with help from the oil and gas sector, as Minister of Natural Resources Jim Carr explains...

It has been said that the best way to predict the future is to create it. That is sound advice for a world that stands at a pivotal moment in its history; a time when climate change is the greatest challenge of our generation and a lower-carbon economy is today's imperative. We should be emboldened by these challenges, and not shy away from them.

It is also helpful for nations such as Canada and the United Kingdom to compare notes through opportunities such as this article. We will not succeed as individual nations unless we recognise the value and importance of working together.

That's why Canada and the United Kingdom were among the 21 members of Mission Innovation last year. The goal of this ambitious new global partnership is to double government investment in clean energy research and development, spur new private-sector spending in clean technology, and enhance international collaboration.

Oil and gas sector leading the way

As Canada's Minister of Natural Resources, I'm proud to say that Canadians across our country are rising to this challenge. And among those helping to lead the way is Canada's oil and gas sector, which is embracing tomorrow's clean-energy world. There are many examples.

First, major Canadian oil and gas companies are making large investments in clean technologies, as well as renewable energy sources such as solar, wind and geothermal, because they realize there is a role – and real opportunity – for them in the fight against global warming.

This is fundamental to our collective future. We are at the crossroads between a global reliance on the fossil

fuels of the past and the renewable energy of tomorrow. But, as our Prime Minister, the Right Honourable Justin Trudeau, has said, "the choice between pipelines and wind turbines is a false one. We need both to reach our goals."

That is why our government is leveraging the fossil fuel resources we have today to support clean-energy solutions for tomorrow. It starts by investing in the clean technologies and innovations that will transform our traditional resource sectors and open up entire new industries. We know that new technologies and innovations will strengthen our economy, ensure our energy security and preserve our planet.

Essential investment in innovation

Second, many people forget that it was innovation that led to the development of Canada's oil sands in the first place. Nobody had figured out how to get oil out of sand until we created the technology.

Canada's oil companies are now working together to develop the next generation of breakthroughs that will significantly improve their environmental performance. For example, through a formal partnership called the Canadian Oil Sands Innovation Alliance, 13 member companies have put aside competitive pressures and, to date, invested more than CAD\$1.3 billion to share more than 800 distinct technologies and innovations.

Our natural gas sector is demonstrating similar foresight and promise. Canada has some of the world's largest known reserves of natural gas and, as its third-largest producer, we are in position to be a major global supplier of liquefied natural gas (LNG). In addition, we have the technology and know-how – in producing, processing and transporting natural gas – to capitalise on its value as a transitional fuel: cleaner than coal or oil and currently more accessible than many renewables.



Our government is doing its part to support a more sustainable role for oil and gas in the clean energy world. We are funding research and development to green the industry's practices as well as modernising our regulatory and review systems to ensure all voices and perspectives are heard and considered in evaluating major new resource projects. This is the only way we can build the right infrastructure to get our resources to global markets and then use the revenues to fund Canada's transition to cleaner forms of energy.

That transition, by the way, is already well-established in Canada.

The time is now

Our clean-tech sector has been consistently outpacing the annual growth rate in the rest of the Canadian economy – and by a significant margin. Our government is determined to maintain that advantage.

That is why we are also investing billions of dollars in the clean technologies and innovations that will increase our supply of renewable energy from solar power, wind energy and nuclear, as well as new and emerging sources such as wave, in-stream tidal, geothermal and biomass.

At the same time, we're building on Canada's enviable reputation as one of the best places to invest and do business. We're committed to maintaining investor certainty; ensuring our tax structure remains among the most competitive; and promoting the benefits of partnering with Canadian companies that have world-class experience and expertise in clean energy and technology.

This may be a time of transition and significant challenges, but it's also a time of unprecedented opportunity – for both our traditional sources of energy and tomorrow's clean energy solutions. This is our chance to shape the future, because the potential is tremendous, the opportunities are clear, and the time is now. ■

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Jim Carr
Minister of Natural Resources
Government of Canada
www.nrcan.gc.ca

Illegal, unreported and unregulated fishing – A global fight worth fighting

Honourable Dominic LeBlanc, Minister of Fisheries, Oceans and the Canadian Coast Guard highlights the devastating effects of illegal and unreported fishing...

Illegal, unreported and unregulated (IUU) fishing is a devastating reality facing the world's fisheries today. This criminal activity undermines the responsible fish management practices of nations and threatens the sustainability of fish resources world-wide. It is estimated that 30% of total global fish catches are derived from IUU fishing and that this illegal activity costs the world economy anywhere from \$10 to \$23bn annually.

IUU fishing also has detrimental effects on our environment, directly contributing to the depletion of invaluable fish stocks, upsetting the delicate balance of vulnerable oceanic ecosystems, and jeopardising the safety of fishers at sea. It is a battle without borders requiring global solutions.

“We are now working with the Arctic Coastal States and other distant water fishing nations to negotiate a new international agreement to prevent unregulated high seas fishing in the arctic.”

Illegal and unreported fishing is not limited to rogue vessels operating outside of existing management regimes. Equally threatening to the conservation of global fish stocks are vessels operating legitimately, but misreporting catch and overfishing.

Canada is fighting IUU fishing on many fronts. One of our most successful efforts is Operation Driftnet, an intelligence-sharing partnership between 2 federal departments – Fisheries and Oceans Canada and the Department of National Defence. Since its inception in 1993, Operation Driftnet has led to a marked decline in IUU fishing in the international waters of the North Pacific. The operation has only had to apprehend 4 vessels since 2001, down from 14 between 1993 and 2001. This international initiative of the North Pacific

Anadromous Fish Commission is complemented by the enforcement activities of Japan, the United States, the Republic of Korea, and the Russian Federation.

Canada is also working with Arctic Coastal States to prevent unregulated commercial fishing in the high seas of the central Arctic Ocean through an international commitment made in the 2015 Oslo Declaration. We are now working with the Arctic Coastal States and other distant water fishing nations to negotiate a new international agreement to prevent unregulated high seas fishing in the arctic.

Canada's expertise in digital forensics has also been used successfully in discovering key digital evidence for major international investigations against suspected illegal, unreported and unregulated fishing vessels. Recent convictions in Sao Tomé and Principe were thanks, in part, to Canada's forensic examination of seized computers, navigational equipment, digital cameras and cell phones.

A collaborative approach is integral to achieving real results in combatting this global problem. Through committed partnerships within the international community we can turn the tide on criminals and protect our marine ecosystems, infrastructure and jobs. Canada recently signed a Joint Statement between Canada and the European Union on Efforts to Combat Illegal, Unreported, and Unregulated Fishing, further strengthening our shared resolve and capacity for increased information-sharing, monitoring and enforcement activities.

Illegal fishers need to sell their catch. The United Nations Food and Agriculture Organization's 2009 Agreement on Port State Measures to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing

CANADA



is an effective mechanism to preventing illegally caught fish from entering international markets.

As a strong supporter, Canada signed the Port State Measures Agreement in 2010 and the Agreement entered into force on June 5th, 2016. Canada believes that now that the Agreement has come into force, we will see a decrease in IUU fishing around the world. While Canada is still undertaking necessary changes to domestic regulations before we are able to ratify the Agreement, we are fully committed to eliminating IUU fishing, and will be ratifying the Agreement at the earliest possible opportunity.

Together with our international partners and governments, Canada will continue its efforts to achieve real results and fight IUU fishing on the world's oceans. Illegal, unreported, and unregulated fishing hurts us all, but, by working together nations can combat this destructive activity. ■



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Honourable Dominic LeBlanc
Minister of Fisheries, Oceans and the
Canadian Coast Guard

Fisheries and Oceans Canada
www.dfo-mpo.gc.ca/index-eng.htm
www.twitter.com/DFO_MPO

An education for every child

The Ministry for Education in Ontario answers Adjacent Government's questions on the importance of every child in Canada benefiting from world class education...

Education in any country is important and it's key that every child has the chance to achieve their full potential. In Canada, it is no different and the Ministry of Education in the province of Ontario strives to provide education and support to pupils of all communities. Here they outline to Adjacent Government their commitment to every child in the province and steps that have been taken to reach these goals.

How important is it for each child in Ontario to benefit from education?

Vibrant communities and a prosperous society are built on the foundation of a strong education system, and the task of the government is to help the province of Ontario's 2 million students reach their full potential.

In 2014, the Ontario government launched [Achieving Excellence: A Renewed Vision for Education in Ontario](#). Its 4 goals are: Ensuring Equity, Promoting Well-being, Enhancing Public Confidence and Achieving Excellence. The vision reaffirms the province's commitment to helping all learners in the province's education system develop the knowledge, skills and characteristics that will lead them to become personally successful, economically productive and actively engaged citizens.

Ontario's publicly funded education system partners with parents, guardians and communities to help develop successful graduates. With a provincial five-year graduation rate of 85.5% – we now have 190,000 additional students who have graduated since 2004 – students who would not have done so had the rate remained at the 2004 level.

How does Ontario's Ministry of Education support schools and pupils in First Nations?

In keeping with our Aboriginal Education Strategy, the ministry continues to focus on reaching 2 primary

objectives: improving student achievement and well-being among First Nation, Métis and Inuit students, and closing the achievement gap between Indigenous students and all other students in Ontario.

“Ontario's investments in its publicly funded education system are paying dividends. The province's strong graduation rate and international test scores confirm our success. But we are not complacent; we know that more work needs to be done to continue improving Ontario's system and help every student reach their full potential.”

The government is also committed to continuing to build positive relationships with Ontario First Nations and working in a spirit of mutual respect through all interactions. Although the Ministry of Education does not provide direct funding for the operation of First Nation schools, the ministry works in partnership with First Nations and the federal government to achieve the goal of the Aboriginal Education Strategy.

We know that strong partnerships between the ministry, school boards, schools, educators, families, students and community organisations are essential in our work. To reach our goals, we have taken important steps in making system-wide changes including targeted funding, professional development and the integration of First Nation, Métis and Inuit perspectives into the curriculum.

How important is it for all young Canadians to understand Indigenous histories and culture?

All students, both Indigenous and non-Indigenous, are enriched by learning about the histories, cultures and perspectives of First Nation, Métis and Inuit peoples in Canada. Also, students are more engaged in their



learning when they see their own communities and cultures reflected in the curriculum.

Since 2003, the Ontario Ministry of Education has engaged a broad range of Indigenous stakeholders and academic experts during the curriculum review process to ensure that the curriculum is more inclusive of First Nation, Métis and Inuit histories, cultures, contributions and perspectives.

Thanks to the contributions of our First Nation, Métis and Inuit partners, every Ontario student is building a greater awareness and understanding of Indigenous histories, cultures and perspectives. The teaching of the histories, culture and perspectives of Indigenous people – including residential schools – is now a mandatory part of the teacher training curriculum.

In 2014, Ontario sent First Nations and Treaties maps

to every elementary and secondary school in the province to help raise awareness about treaties. These maps and the accompanying teaching resources are helping students to learn about the significance of the treaties and the shared history of First Nations and non-Indigenous Ontarians. Our province has designated the first week of November as Treaties Recognition Week to promote public education and awareness about treaties and treaty relationships.

How can this help to develop greater community throughout the country?

Ontario's diversity is one of the province's greatest assets. Embracing this diversity and moving towards inclusivity and respect will help us reach our goal of making Ontario's education system the most equitable in the world. Everyone in our publicly funded education system – regardless of background or personal circumstances – must feel engaged and included.

How important is integration in schools in order to bring together different communities?

Ontario schools need to be places where everyone can succeed in a culture of learning and high expectations. The government’s work over the past decade has been focused on helping all children and youth reach their full potential by giving them the tools to help overcome obstacles. We are seeing the results, which includes a culture shift in schools that recognises diversity as a contributor to success, and not a barrier. The fundamental principle driving this work is that every student has the opportunity to succeed, regardless of ancestry, culture, ethnicity, gender, gender identity, language, physical and intellectual ability, race, religion, sex, sexual orientation, socio-economic status or other factors.

“We know that strong partnerships between the ministry, school boards, schools, educators, families, students and community organisations are essential in our work. To reach our goals, we have taken important steps in making system-wide changes including targeted funding, professional development and the integration of First Nation, Métis and Inuit perspectives into the curriculum.”

How does the ministry support Achieving Excellence throughout Ontario with investments such as the recent \$7M for First Nations Métis and Inuit students?

Ontario’s Aboriginal Education Strategy sets the foundation for improving achievement among Aboriginal students in provincially funded schools and supports life-long learning beginning in the early years and continuing through postsecondary, training or workplace opportunities. In 2016-17, Ontario’s targeted investments for Indigenous education will be more than \$71mn.

Some of the more recent investments will help provide all school boards with a new senior-level position dedicated to supporting First Nation, Métis, and Inuit

education initiatives. This initiative clearly demonstrates Ontario’s support for the education recommendations of the Truth and Reconciliation Commission. In addition, this new position will promote a greater awareness of Indigenous histories, cultures, perspectives and contributions among all students, while developing greater community and family engagement.

Ontario’s support for Indigenous students is part of the province’s overall annual education budget, which is estimated to be \$22.9bn for 2016-17.

How can investments such as this help to deliver world class education for all?

Ontario’s investments in its publicly funded education system are paying dividends. The province’s strong graduation rate and international test scores confirm our success. But we are not complacent; we know that more work needs to be done to continue improving Ontario’s system and help every student reach their full potential. Equity remains a key goal of our education system, and through our many investments in education, we are committed to helping all of our students achieve success in school and beyond. ■



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Ministry of Education
Government of Ontario
www.edu.gov.on.ca/eng

The relationship between policy and Indigenous education in Canada

Michelle Pidgeon (SFU), Dawn Zinga (Brock), and Sandra Styres (OISE) look at how the relationship between policy and Indigenous education in Canada has evolved...

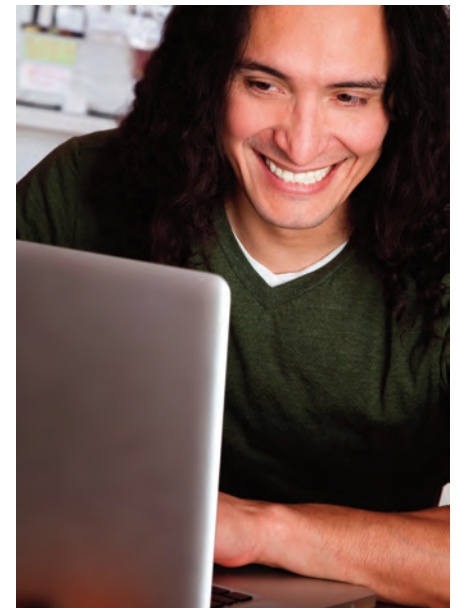
The relationship¹ between policy and Indigenous² education in Canada has been contentious to say the least and one that has been predominately dictated by the Crown's relationship to Canada's first peoples³. Initially through the Royal Proclamation of 1763⁴, and then later the Indian Act 1876⁵, Aboriginal K-12 education is a federal responsibility while constitutionally, education for non-Aboriginal peoples is a provincial oversight⁶.

From a decolonising perspective, respecting the diversity of over 60 different Indigenous nations⁷, which represent as many cultures and languages is critical to counter the colonially imposed government defined parameters and terms⁸. This acknowledgement of diversity of nations is critical to shifting the policy discourses that aim to see Aboriginal peoples as homogeneous to one that speaks to diversity as empowering Aboriginal nations' self-determination.

During the 1800s to 1950s, Aboriginal education had the purpose of assimilating Aboriginal peoples into society. Removing the Indian from the child was the intentional purpose of schooling, and main directive of residential schools⁹. Education at this time had little focus on post-secondary aspirations or attainment outside of the preparation of Indigenous peoples to do low skilled jobs (e.g., housekeeper, farmer) (Battiste & Barman, 1995;

Royal Commission on Aboriginal Peoples, 1996; Truth and Reconciliation Commission of Canada (TRC), 2015b)¹⁰. The federal and provincial policies remained essentially unchanged until the later part of the 50s and into the 1960s, when more Aboriginal communities and organisations (e.g., the National Indian Brotherhood, now the Assembly of First Nations) became influential across several areas including education, policy, and legal advocacy. This leadership and advocacy signalled that important political, social, and cultural change was coming for Indigenous peoples.

For example, in 1969, the Minister of Indian Affairs, Jean Chrétien, presented Statement of the Government of Canada on Indian Policy, which aimed to set out a new relationship between Aboriginal nations and the federal government (Chrétien, 1969). The challenge was that this document did not include Indigenous perspectives on their own futures; in response the National Indian Brotherhood released the document entitled Indian Control over Indian Education to outline an Indigenous vision for education of their peoples: parental responsibility; programs, curriculum, and values; teachers and counsellors; facilities and services; and research (National Indian Brotherhood, 1972; Pidgeon, Muñoz, Kirkness, & Archibald, 2013). The National Indian Brotherhood (1972) clearly stated, "We want education to give our children the knowledge



to understand and be proud of themselves and the knowledge to understand the world around them" (p.1). This position has not changed since the 1970s; in a recent statement regarding the constitutional right of Indigenous peoples to education across the life span, the Assembly of First Nations (2012) stated:

Section 35 (1) of the Constitution Act of 1982 recognises Aboriginal and Treaty rights and affirms First Nations inherent right to self-government including the creation of laws and systems for the provision of lifelong learning for First Nations populations. First Nations expect the Crown, not only to recognise their jurisdiction to lifelong learning, but also to "fulfil their Constitutional, Treaty and international obligations to First Nations peoples by supporting the

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design and implementation of First Nations comprehensive learning systems with adequate and sustainable resourcing” (p. 5).

“During the 1800s to 1950s, Aboriginal education had the purpose of assimilating Aboriginal peoples into society. Removing the Indian from the child was the intentional purpose of schooling, and main directive of residential schools.”

These philosophical differences on the responsibility of education and the purpose of education continued to influence how Aboriginal education was supported and experienced within the K-12 system. Given the disparities in health, education, and other social indicators between Aboriginal and non-Aboriginal Canadians, the Royal Commission on Aboriginal Peoples (RCAP) (1996) was established to better understand Aboriginal and non-Aboriginal historical and contemporary relations through national consultation and research¹¹. The RCAP report dedicates one entire volume to the educational experiences of Canada’s First Nations, from assimilationist policies and practices (e.g., residential schools), the Aboriginal post-secondary funding program and the impacts that such limited funding opportunities have had on post-secondary educational attainment, and the establishment of specific Aboriginal programs, services, and even institutions (Fisher et al., 2006; RCAP, 1996). And now, we see the recommendations from the Truth and Reconciliation (TRC) (2015) reports, resonating familiarity with RCAP (1996) recommendations and clearly implicating the Canadian educational system in failing Aboriginal children, and the rest of Canada in its continued apathy towards Aboriginal peoples in this country.

Moving Forward

Statistics and research reports continue to demonstrate that the educational system’s fractures are still not all healed. There is still much work to be done at the policy and practice levels to create a higher education system that supports Indigenous learners and their communities, with respectful, relevant, reciprocal, and responsible education (Kirkness & Barnhardt, 1991). As a society we are still dealing with: the educational

attainment gap between Aboriginal and non-Aboriginal peoples (White, Beavon, Peters, & Spence, 2009); the intergenerational trauma of residential schools; systemic, overt, and covert forms of racism in educational policies and practices (Royal Commission on Aboriginal Peoples, 1996); and chronic underfunding at the K-12 and PSE systems for infrastructure, positions, and scholarships (Howe, 2004; Malatest & Associates Ltd., 2004; Usher, 2009).



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There has been a steady increase in the high school completion rates of Aboriginal youth, with more and more being “post-secondary ready” – i.e., prepared to enter college or university upon graduation. The challenge is that within this growth, there is clear differentiation of completion rates between on- and off-reserve schools, with on-reserve high school completion rates still remaining low across each province and territory (Richards, 2013). High school completion rates impact readiness of this group to enter into university or college; and for the non-completers it directly influences when they may choose to pursue further

education (e.g., waiting until they are older than 21 to enter as mature students)¹². One must also consider the connection between the K-12 to higher education, and how Aboriginal students are being prepared to be ready for higher education. Within the K-12 system across the country there have been concerted efforts to make K-12 a better place for Aboriginal students, with the aim of increasing high school graduation rates. For example, British Columbia’s Ministry of Education has been articulating policies with its school districts and Aboriginal communities called “Aboriginal Education Enhancement Agreements¹³” yet only

2 of the over 50 agreements specifically mention post-secondary education (Kitchenham, Fraser, Pidgeon, & Ragoonaden, 2016). Approaching support services from a strengths- or gifts-based approach honors the cultural integrity of the Indigenous student (Pidgeon, 2016; Pidgeon, Archibald, & Hawkey, 2014). Within this discussion there is recognition that barriers exist, whether structural, social, economic, etc., that hinder Aboriginal student success.

As a direct result of assimilationist policies and ongoing colonial practices there are systemic problems within the Canadian education systems and society. There is still much work to be done to have policies and practices that are inclusive and respectful of Indigeneity. There are many Indigenous and non-Indigenous peoples working to make systemic changes across our educational system. The work will not be in vain. It will take time, and it will be an ongoing process, and it is time for all of us to further support Indigenous empowerment and self-determination.

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1 In the founding of Canada as a British Colony, Aboriginal peoples residing in what is now Canada were not seen as equal nations. Instead, the land was seen by Europeans as a terra nullius (nobody's land) and free for the taking. Over time, this relationship between European settlers and documents such as the Royal Proclamation of 1783 and the Indian Act 1876 (and its subsequent amendments which are binding to this day), set out the relationship between the Crown and Aboriginal peoples. The term "unceded territories" acknowledges the fact that the land that is known as Canada was occupied prior to colonisation and Aboriginal peoples did not relinquish their rights to these lands through treaty or other means. Aboriginal peoples did not legally give up their territories and lands; they were dislocated from their lands through policy and practices of colonisation in what we now refer to as Canada. (Royal Commission on Aboriginal Peoples (RCAP), 1996) (also see: <https://www.aadnc-aandc.gc.ca/eng/1100100013778/1100100013779>)

2 Indigenous peoples, including First Nations, Métis, and Inuit, are the fastest growing population in Canada, according to Statistics Canada (Statistics Canada, 2013). In the 2011 National Household Survey (NHS) there are 1,400,685 people self-identified as having an Aboriginal identity, representing 4.3% of the total Canadian population, an increase from 3.8% in the 2006 Census (Statistics Canada, 2013).

3 The terms Indigenous and Aboriginal interchangeably to refer, broadly, to the first peoples of Canada (formerly referred to as "Indians"), including First Nations, Métis, and Inuit peoples and, where appropriate, more specific terms that speak to how groups self-identify (e.g., Mi'kmaq, Cree, Sto'lo, Inuit)

4 For more information on the Royal Proclamation see <https://www.aadnc-aandc.gc.ca/eng/1370355181092/1370355203645>

5 For more information on the Indian Act see <http://laws-lois.justice.gc.ca/eng/acts/i-5/>

6 It is important to acknowledge that the Crown does not view Aboriginal higher education is not seen as a legal responsibility, but Aboriginal peoples saw their early negotiations with the Crown to include education across the life-span from early childhood to post-graduate education (RCAP, 1996; Stonechild, 2006).

7 There are others who do not fit neatly into one of the three recognised groups of Indigenous people. There are those who come to learn of their Aboriginal ancestry later in life – e.g., as a result of being adopted out into non-Aboriginal families, particularly during "the 60s scoop," a period when Aboriginal children were taken into foster care and adopted out (Royal Commission on Aboriginal Peoples (RCAP), 1996). This could also result from a family's decisions to not disclose their Aboriginal identities to their descendants. The history of colonisation, government policy, and politics regarding who is defined as Indigenous and by whom (e.g., community, federal government) has had profound impacts on Indigenous individuals, families, communities, and nations that continue across society today (Royal Commission on Aboriginal Peoples (RCAP), 1996; Truth and Reconciliation Commission of Canada (TRC), 2015a, 2015b).

8 Colonially imposed terms include is "First Nations," which results from the Indian Act of 1876, while amended over time, its defined power of relationship of the Crown over Aboriginal education has remained essentially unchanged. The Métis are a unique cultural group who have First Nations and European ancestry, their own language and cultural practices, and are recognised as one of three Aboriginal groups within Canada in the 1982 Canadian Charter of Rights and Freedoms. The third group, the Inuit, are Indigenous peoples who live in the Arctic and northern regions of Canada (Royal Commission on Aboriginal Peoples (RCAP), 1996).

9 Residential School. Residential schools (e.g., boarding schools) and Indian day schools were primarily operated from the early 1800s to 1996 across Canada by various religious orders with the aim of assimilation and removing the "Indian" from the child (e.g., no Aboriginal language or cultural practices were allowed). The Truth and Reconciliation Commission (TRC) (2010-2015) sought to witness and document the intergenerational trauma from residential schools. It had the mandate to learn the truth about what happened in the residential schools and to inform all Canadians about what happened in the schools. ... Reconciliation is an ongoing individual and collective process, and will require commitment from all those affected including First Nations, Inuit and Métis former Indian Residential School (IRS) students, their families, communities, religious entities, former school employees, government and the people of Canada. (Truth and Reconciliation Commission of Canada (TRC), para. 3-4)

This commission documented the stories of survivors of residential schools, hearing more than 6,750 testimonies and collecting documents, pictures, and other artefacts along the way. The TRC final reports spanning 10 volumes documenting the notable atrocities such as physical, emotional, and sexual abuse, death in care, and the intergenerational trauma that resulted from children being taken away from their families, their cultures, and their homes (Truth and Reconciliation Commission of Canada (TRC), 2015a). The Calls to Action speaks directly to the responsibility that education has in reconciliation (Truth and Reconciliation Commission of Canada (TRC), 2015b).

10 Aboriginal persons who did pursue their university degrees (or became ministers of religion, thus educated) and were under the jurisdiction of the Indian Act of 1876, lost their federal status as First Nations persons, which had intergenerational repercussions for their descendants (Furi & Wherrett, 1996). Amendments to the Indian Act in 1951 and Bill C-31 in 1985 sought to rectify such "acts" that resulted in disenfranchisement and to align the outdated policy with the Canadian Charter of Rights and Freedoms:

The amendments were intended to remove discrimination, restore status and membership rights, and increase control by bands over their affairs. The federal government continues to maintain control over who is registered as an Indian and the rights that flow from registration. The bill represented a compromise between the positions of Aboriginal women and non-status Indian groups, and the national status Indian organisation, the AFN. (Furi & Wherrett, 1996, p.4)

However, the legacy of disenfranchisement still has lasting impact of many Indigenous families who were directly affected by these policies.

11 <http://www.thecanadianencyclopedia.ca/en/article/royal-commission-on-aboriginal-peoples/>

12 The common conception is a mature learner is someone who is over 21 years of age. See Ryerson, University of Western Ontario,

and Memorial University for examples: <http://www.ryerson.ca/undergraduate/admission/admissions/mature.html> ; http://welcome.uwo.ca/admissions/admission_requirements/mature_and_senior_applicants.html ; <http://www.mun.ca/regoff/calendar/sectionNo=REGS-0289> . Other institutions, like Simon Fraser University, see mature learners as 23 or older, e.g., <https://www.sfu.ca/students/admission-requirements/profile-mature.html>

13 See <http://www.bced.gov.bc.ca/abed/agreements/> for more information about the AEEA in British Columbia



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Featured ebook



Indigenous students within higher education

In this e-book we focus on exploring the complex contexts and realities of Indigenous students in higher education and the important role of Indigenous student services. When Indigenous students pursue studies at higher education institutions their transition will be like that of many other students entering into a new context with new levels of autonomy and new expectations but unlike their fellow classmates their very identities have been politicised and add different layers onto the transition experience. Like their classmates, Indigenous students have unique family backgrounds and cultural experiences that may find resonance with other students from similar backgrounds, but unlike their classmates they consciously and/or unconsciously carry the history of colonisation and the scars that colonial acts have inflicted on themselves, their families, and their peoples. They are entering into institutions of higher learning that at one point required enfranchisement (the unwilling relinquishing of Indian status) as a condition of admission as required by an amendment to the 1876 Indian Act.



To read the
digital ebook

Embracing cultural values in Canada

The Department of Education, Culture and Employment, Government of the Northwest Territories details the importance of cultural and heritage values across the different regions of the country...

Culture and heritage are powerful components of any society. Culture is the living expression of our values, and heritage encompasses the tangible and intangible things we wish to bring to the future. Together, culture and heritage help us adapt to changing times. Culture keeps our past alive and fosters pride in where we have come from and where we now live. Culture and heritage define us, tell others who we are, and provide a solid foundation for understanding our place in the world.

In Canada, our cultural values include equality, religious freedom and inclusiveness. These values are rooted in our diversity, beginning with the Indigenous peoples of Canada, and then with people from across the globe who have come to live here. While our diversity makes Canadian identity difficult to define, it is what instills in us a sense of pride and helps us promote tolerance. Recently, we have paid particular attention to the need for reconciliation between Indigenous and non-Indigenous Canadians.

Canada's northern territories (Yukon, Nunavut, and the Northwest Territories), are marked by large geographic size, unique and sometimes harsh climate, and a high proportion of Indigenous peoples compared to the rest of Canada. The Northwest Territories (NWT) for example, covers 1.35 million square kilometres with a total population of just over 41,000. There is no single Indigenous "culture" in the NWT; the Dene, Cree, Métis, and Inuvialuit people, which comprise approximately 50% of the population, are characterised by their linguistic and cultural diversity. Indigenous knowledge about how to survive and, indeed, to thrive and live harmoniously in our northern landscape has been passed on for generations, and helps us navigate the challenges of present day. The other 50% of the territory is comprised of people from a wide variety of cultural

and ethnic backgrounds, creating a vibrant multicultural community.

Raising the importance of the culture and heritage of Canada and the NWT is critical. When people are connected to culture and heritage, we use our knowledge of the past, in the context of the present, to make wise choices for the future.

The primary role of culture and heritage resides with families and individuals. Yet, through its strategies and resources, the Government of the Northwest Territories (GNWT) is a steward, collaborator, and contributor to culture and heritage.

Since 1997, the GNWT has had a policy that acknowledges the important and essential role that Indigenous traditional knowledge plays in helping to make present-day decisions about the land and natural resources. More recently, the GNWT created a Culture and Heritage Strategic Framework, whose purpose aligns the work of all government departments around a shared set of cultural principles until 2025. The principles are based on a blend of Indigenous and non-Indigenous cultural values. The Framework explicitly recognises that culture and heritage both influence, and are influenced by, the work of public government.

Education in the NWT has a strong cultural component, with a specific commitment to having curriculum and programming reflect the perspectives and values of the Indigenous people of the territory. Two foundational frameworks, *Dene Kede* and *Inuuqatigiit*, are used to guide all curriculum development.

All NWT educators receive 2 days of cultural orientation each year as part of the Department of Education, Culture and Employment's ongoing commitment to



supporting the professional learning of teachers, providing cultural context for all learning in the classroom.

Cultural perspectives are built into a wide range of curricula, including science and, particularly, language arts, social studies and northern studies. The latter course is a mandatory high school course for all students, where they explore their own Northern identity, the history, land claims, economy and major issues facing our territory.

“Raising the importance of the culture and heritage of Canada and the NWT is critical. When people are connected to culture and heritage, we use our knowledge of the past, in the context of the present, to make wise choices for the future.”

A major directive funds cultural and language programming in all schools in the NWT, and supports on-the-land learning activities.

Operated by the GNWT, the Prince of Wales Northern Heritage Centre acts as the territorial museum and archives, as well as housing the offices of the Culture and Heritage Division including the archaeology program, geographic names, and arts and culture funding. Through exhibits, public programs (guest lectures,

presentations, theatrical performances), and school programs, the Centre plays a central role in presenting, preserving, and promoting the cultures and heritage of the NWT.

We take an inclusive view of culture – encompassing how culture interplays with wellness, education, the economy, the natural environment, the arts, and traditional practices; and inclusive of the many cultures that have contributed to the fabric of NWT society. We see our primary role as cultivating strong relationships with NWT residents, portraying culture and heritage from the point of view of the people who are the subjects of our programs. ■

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Cognitive brain health in aging: Why is it so important for women?

Yves Joanette from the Institute of Aging, and Cara Tannenbaum from the Institute of Gender and Health at the Canadian Institutes of Health Research, detail why cognitive brain health is so important as we age, specifically for women...

Remaining cognitively healthy as we age is something we all desire. Dementia – a progressive deterioration of cognition accompanied by personality and mood changes – ranks highest among mid-life and older adults' concerns about growing old. This fear is justified, and is based on hard facts: dementia affects less than 3% of adults between the ages of 65-75, with a sharp rise in prevalence to 30 to 40% at age 85 and beyond. Like many other health and social issues, the lifetime probability of being diagnosed with dementia is not an equal gender opportunity for women and men. Women are almost twice as likely as men to be living with dementia, representing 70% of all cases worldwide.

Women's increased longevity is not sufficient to explain the fact that women are far more likely to develop the

disease, and to decline more rapidly, both cognitively and functionally, compared to men. Sex hormones and hormone replacement therapy may play a role. During the 1980's and 1990's, hormone replacement therapy was liberally prescribed to peri- and post-menopausal women prior to the discovery that hormone replacement increases dementia risk, the exact opposite of what was predicted. Women may also be more vulnerable to recurrent stressful life events than men. Stress hormones affect the female brain differently over time, possibly leading to more memory impairment, inflammation, damage and degeneration. The reason why dementia disproportionately affects women in both prevalence and severity, the biologic mechanisms underpinning these sex differences, and the socialised gender roles that make women more vulnerable, have yet to be fully understood.

CANADA

The World Health Organization (WHO) recognises that dementia is a leading public health threat for the world. Estimates indicate that the number of people living with dementia will double in high-income countries, and more than triple in low- and middle-income countries. Older women will be most affected, and younger women will bear the brunt of the caregiving burden. The effect this will have on the expanded family structure, and on the mental health and resources of affected individuals raises significant concern.

To address this challenge, the UK government led the 2013-2015 joint effort of all G8 countries to establish the Global Action Against Dementia initiative. The WHO scaled up this commitment at its March 2015 First Ministerial Conference on Dementia, where 93 countries agreed to work together to face the challenge of dementia. The World Dementia Council is helping to lead and coordinate this global effort along with the WHO, the OECD and many international and national organisations, including associations representing people living with dementia.

One priority is for future research efforts to be sex sensitive in order to understand the root cause and progression of the neurodegenerative diseases causing dementia. Currently, only a small proportion of national and international research efforts include sex and gender variables or considerations at all levels of their analyses. One example is the Canadian Consortium on Neurodegeneration in Aging, supported by CIHR and many partners, in which more than 350 researchers from across Canada focusing on all aspects of dementia research – from basic biomedical to social dimensions – are encouraged to include sex and gender at all levels of their research. This unique effort was made possible through advocacy from one of the partners of this Consortium, the Women’s Brain Health Initiative, who brought attention and extra funding to support the women in dementia dimension.

Fortunately, we now have a better understanding of how brain health can be optimised to push back the onset of dementia. One strategy is to reduce vascular risk factors, such as high blood pressure and obesity. Another is to avoid events known to trigger neurodegenerative conditions, such as early life head injuries and concussions, which occur in women due to sports

and domestic violence. Men are believed to have more cognitive reserve than women; women can be taught compensatory strategies to recruit more parts of their brains. Prevention also requires being physically active throughout the lifespan. Prevention may involve de-prescribing drugs, such as sleeping pills and some classes of anticholinergic medication that are now known to affect memory and concentration. Women are more frequent consumers of these medicines than men. Putting in place de-prescription drug policies that encourage patients, pharmacists and physicians to curb the use of these drugs may help reduce the risk of dementia.

Cognitive brain health in aging is important for everyone, but even more so for women. Innovation and transformation in health care delivery to better serve those living with dementia will need to be considered from an equity standpoint, to include women’s priorities. This is equally true for programs meant to encourage the social inclusion of those living with dementia, such as the UK and the Canadian Dementia Friends programs.

A complementary set of research, care and social policies will allow us to tackle and overcome the critical and specific challenges of dementia in women. ■

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Kid's health and exercise research: The whole kit and caboodle

Scientists at the University of Calgary's Human Performance Laboratory take a holistic approach to kid's health and exercise research...

The physiology of exercise in children is different than in adults. This presents an attractive paradigm for scientists to explore, particularly from a health research perspective. However, interventions addressing health and exercise are all-consuming with many complexities (Booth and Layer 2009). Yet often the question arises, why do so many researchers study things that seem to be common knowledge and 'just so obvious'?

Common knowledge

The majority of the public are aware that obesity rates among children and youth in Canada have nearly tripled in the last 30 years. Certainly, the public would have some knowledge that 10% or less of 5 to 17 year olds actually meet the daily recommended 60 minutes of moderate to vigorous physical activity. Not surprising, but perhaps less well-known is that 40% of children aged 5 to 8 have at least one cardiovascular (CV) risk factor (Rodd and Sharma 2016). This inadequate level of exercise combined with being overweight or obese leads to premature or accelerated vascular ageing. Therefore, unless effective interventions are developed to reduce obesity, children today may live less healthy and shorter lives than their parents.

Injury prevention

Childhood obesity tracks more strongly than any other risk factor and low cardiorespiratory fitness frequently

occurs with it. Faculty of Kinesiology researchers have spent years investigating the interconnectedness of obesity to poor aerobic capacity, vascular inflammation and endothelial injury. We used a three-pronged approach to develop the BE HIP study (Biochemical Evaluation during a Health Intervention Programme), focusing on: 1) children at risk, 2) investigating and understanding obesity-influenced mechanisms of vascular injury, and 3) optimising injury prevention through progressive exercise. A not uncommon approach to an intervention, certainly ambitious and obvious since exercise is known to benefit health, but complicated because of the population age.

Complicated

The physiological benefits of exercise support the idea that studies must implement strategic methodological designs to ensure that participants are not denied the ability to move. We employed a crossover design to ensure all participants could take part and benefit from the 10-week intervention while still providing a valid control group for statistical analysis of the results (Ratkowsky et al., 1992). This required doubling the study duration from 10 to 20 weeks.

Individuals at risk

The utility of clinical markers associated with exercise prevention were originally lipid based and related to insulin/insulin resistance. An upcoming method for identifying risk for obesity

was through the use of adipocytokines biomarkers, such as leptin and adiponectin. Both are abundant in adipocytes, i.e. fat, derived hormones in healthy humans (Natuzzi 2005). They are important in the regulation of body composition and the low-grade inflammatory state associated with obesity. Leptin correlates positively with body mass index (BMI) and fat mass, and negatively with fat-free or lean mass (Blum et al., 1997). Adiponectin is decreased in obese, has an anti-inflammatory action and inhibits pro-inflammatory tumour necrosis factor-alpha (TNF- α) secretion by macrophages (Yokota 2000). We measured TNF- α also and quantified body composition by DXA because it was more relevant clinically for intervention success. Despite the above, a noticeable gap in the literature existed regarding the energy expenditure (exercise) relationship between leptin and adiponectin concentrations in pre-pubertal children (Venner et al., 2016).

Gap in the literature

We first published a purposeful literature review titled 'Leptin as a potential biomarker for childhood obesity' (Venner et al., 2006). This was followed by a second paper titled 'A Meta-Analysis of Leptin Reference Ranges in the Pediatric Prepubertal Children', because so few publications existed compared to the numerous ones in human adults (Venner et al. 2008). We were cautious when inter-

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preparing individual leptin values and when referring to the published values and means because of the dependency of leptin levels on age and sex. Our most recent paper – ‘Changes in leptin and adiponectin concentrations during a high intensity exercise intervention programme for obese children’ (Venner et al., 2016) – describes these results.

Mechanisms of cardiovascular injury

The mechanisms influencing vascular inflammation and endothelial injury in childhood are directly related to the observed risk factors associated with development of atherosclerosis. Each risk factor exists within a behavioural, environmental, physiologic, and genetic context that provides the rationale for its consideration and whether it could be used to identify a child at risk. This is where it becomes all-consuming since conditions of family life (socio-economic status, ethnic origin), comorbidities that may or may not accompany overweight/obesity status (fat mass, blood pressure), and behavioural factors related to energy expenditure (nutrition/diet, activities in school, physical inactivity), must be measured. Accounting for all of these risk factors requires a holistic approach and careful consideration must be given to participant burden, namely the parent(s) who provide much of the information.

Health education

The hardest aspects of reducing CV risk involve behavioural change. The BE HIP study provided an effective setting to include three nutrition and two parental health education sessions on lifestyle choices, a cornerstone of paediatric care (Miller and Silverstein 2007). Interactive dietary activities to engage the families were developed



by a registered dietitian. The Family Eating and Activity Habits questionnaire was used to monitor family behaviour and to log environmental modifications associated with diet changes (Golan and Weizman 1998). General physical activity was tracked throughout the study with the Leisure Survey Index (LSI) questionnaire (Godin and Shephard 1985).

Optimising injury prevention through exercise

Children, by nature, play in a stop-start fashion and therefore exercise scientists often find it difficult to assess their level of physical capacity. Their changing physiology and growth variations require serial measurements to avoid confounding the results. Although pre-pubertal children respond to exercise training, they don't necessarily demonstrate changes in peak oxygen consumption. Heart rate monitors and accelerometers were used to quantitatively assess the twice per week 60 minute exercise sessions through activity counts.

High Intensity Exercise

The programme focused on a progressive increase in high intensity exercise

at each session for a total of 20 minutes by week 10 (Doyle-Baker et al., 2011). High intensity was defined as a heart rate that was $\geq 75\%$ of the participant's HRmax with low-to-moderate intensity as $< 75\%$ of HRmax (ACSM 2005). Two certified (AFLCA) instructors facilitated the exercise classes which employed a wide variety of activities, i.e. group games, (dodge ball, tag) and running laps, so as to meet the prescribed intensity at each session.

The whole kit and caboodle approach

In summary we investigated the effects of an intervention on anthropometric, metabolic and cardiovascular parameters in obese children. Pragmatically, BE HIP involved the whole kit and caboodle as it was a comprehensive approach that incorporated health education, increased exercise at a level that appropriately engaged kids and resulted in both positive clinical outcomes and behavioural changes within their families.



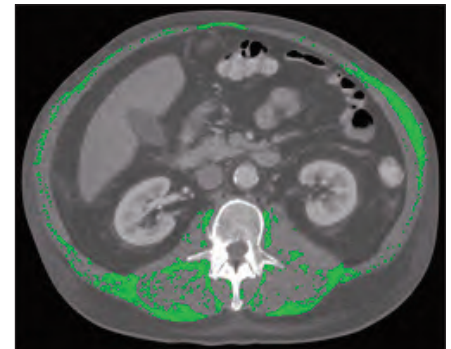
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Disease-associated myosteatorosis in people with cancer: Can it be treated?

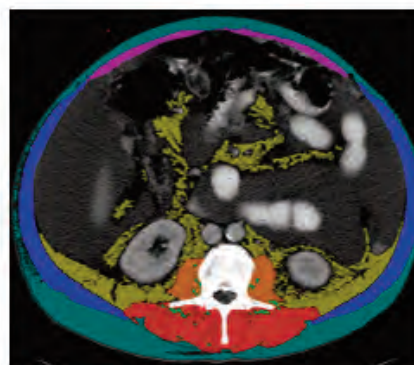
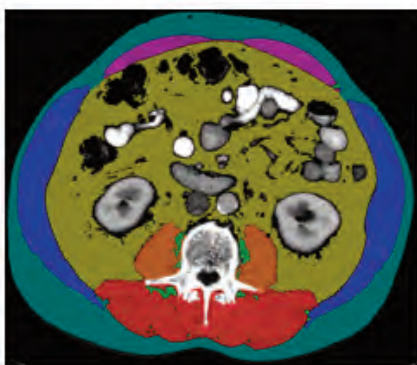
Pathological fat infiltration into muscle is a feature of disease-induced muscle loss that significantly associates with shorter survival in people with cancer. Fat is associated with skeletal muscles in the form of intra-myocellular lipid droplets within the cytoplasm of myocytes as well as intermuscular adipocytes. These lipid stores are thought to provide fuels for skeletal muscle contraction, however, excess deposition of triglycerides within cells and organs that normally contain only small amounts of fat (such as liver, pancreas, skeletal and cardiac muscle) is defined as steatorosis. Myosteatorosis (steatorosis of the muscle) is a pathological phenomenon reflecting an impairment of synthesis and elimination of triglyceride.

Myosteatorosis is revealed in vivo by computed tomography (CT) imaging as muscle with low radiodensity combined with presence of intermuscular adipose tissue. The evidence for a relationship between low muscle radiodensity and shorter survival in people with cancer is building. Loss of skeletal muscle mass appears to generally occur with accumulation of adipose tissue during treatment for cancer, whereas patients who supplemented their daily intake with fish oil containing eicosapentaenoic acid and docosahexaenoic acid [EPA+DHA (2.2 g/day)] maintained or gained muscle



This slide shows a CT image from a cancer patient who underwent 16 weeks of first line platinum doublet chemotherapy for lung cancer. Only the intramuscular adipose tissue is shown in color

mass and experienced a decline in intermuscular adipose tissue over the same time period. This intervention also resulted in a greater response by the tumor to the drugs being used to



Skeletal Muscle

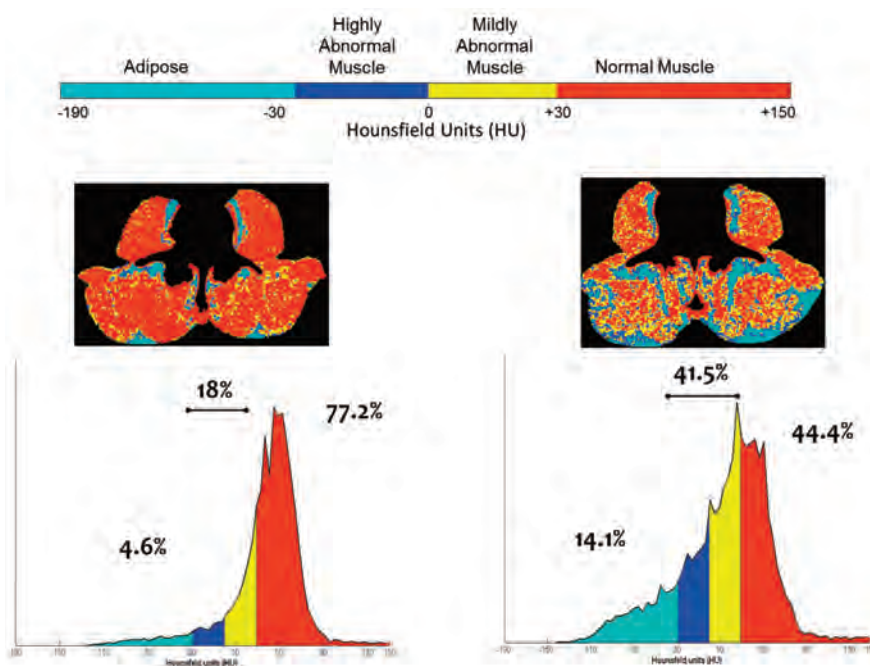


Adipose Tissue



To quantify different tissues for body composition analysis using computed tomography imaging, a bony landmark is used to consistently measure the same region of the body across patients. The 3rd lumbar vertebrae is an established landmark in body composition analysis that correlates with amount of whole body muscle and fat. Each tissue attenuates radiation in a specific way which is recognised by a software program to enable skeletal muscles and different types of adipose tissues to be identified. Each tissue of interest is then color coded (see legend). When more than one CT image exists in the patient record, tissue changes over the trajectory of the disease can be determined. This image presents 2 scans taken approx 6 months apart at the same region within the same patient. The marked decline in muscle and adipose tissue is evident, concurrent with deposition of adipose tissue into muscle

Illustration of Variation in Muscle Radiodensity



An illustration of annotated CT images, and accompanying histograms of radiation attenuation showing the percentages of total tissue cross-sectional area within the ranges of adipose tissue in paraspinal/psoas muscles is useful to understand the problem of myosteator. This illustration shows the percentages of total tissue cross-sectional area within the typical attenuation ranges determined for the respective tissues for 2 subjects. Subject 1 is a 63 year old male with muscle characteristics at the median values for male cancer patients with a diagnosis of solid tumor at our centre. For Subject 2 there is extensive macroscopic adipose tissue and less than half of the cross sectional area of his muscles falls within the normal attenuation range. Overall, Patient 1 has a greater proportion of fat and low attenuation muscle, than muscle with normal characteristics. Patient II is remarkable in several respects, including extensive visible fatty infiltration and extremely high proportion of total muscle area falling within a range of attenuation values generally recognized to be abnormally low (adapted from Aubrey et al 2014)

treat the cancer. Therefore there may be multiple benefits of dietary fish oil to the cancer patient undergoing treatment.

To explore these observations that cancer patients supplementing with EPA+DHA experience an improvement in myosteator, we established a pre-clinical model to enable intervention with EPA+DHA at various time points in the cancer trajectory. We used an rat model bearing the Ward colorectal tumor and treated in a manner that mimics standard clinical care for this disease in humans with respect to the types of drugs used and the toxicities they evoke. Using this model we have demonstrated that the results align with our human data suggesting an improvement in muscle condition concurrent with a better response by the tumor to the anti-cancer drugs.

Using this as the rationale for the next step of this line of questioning, we have planned a clinical trial upon which to test the biological efficacy of fish oil to reverse cancer-associated myosteator in a cancer population known to exhibit myosteator, verified by in vivo imaging of muscle features by CT scan. At the time of diagnosis and treatment planning, patients will be randomized and consented to consume EPA+DHA (2.2 g per day) until day of surgery (at least a 4 week period) or receive standard of care (no intervention). Muscle from the subjects will be collected at the time of surgery and prepared for analysis. Analysis of the muscle tissue will enable determination of differences in Triglyceride-fatty acid content (a hallmark of myosteator). We expect that this research will verify the tantalizing evidence we have in hand

that suggests an improvement in pathological features of myosteator by dietary EPA and DHA. If so demonstrated, this work will provide critical translational knowledge required to effectively plan treatment interventions that have significant potential to impact the lives of people diagnosed with cancer, a major cause of death globally.



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Lessening the burden of traumatic brain injury

Drs. Elizabeth Theriault, Ramona Hicks and Patrick SF Bellgowan shed light on the burden of traumatic brain injury and the need for better diagnosis and treatment...

Given the high socio-economic burden, traumatic brain injury (TBI) has become one of the major priorities in the medical research agendas of many countries¹. A recent Canadian study examined the socio-economic burden of 14 neurological conditions, data based on records of hospitalisations, and reported that next to Alzheimer's and other dementias, TBI is and will continue to be, the second highest neurological condition requiring informal care². The indirect costs due to working age disability will be the greatest for TBI of all the conditions studied. In fact, sustaining a TBI has a very large effect on employability as well as on subsequent homelessness: in Canada, 65% of adult homeless have sustained a TBI, in most cases prior to becoming homeless³, findings corroborated in a study conducted in the UK⁴. Among homeless youth aged 19-24, 49% have suffered a moderate-to-severe TBI, a quarter of them suffer depression and three-quarters are drug-dependent³. A study of homelessness in Minnesota demonstrated 43% of homeless adolescents had TBI, including an earlier age of homelessness and higher incidence of psychiatric symptoms and poorer Activities of Daily Living (ADL) standards⁵.

Although an intensive effort is underway to develop modern diagnostic criteria to index the severity of traumatic brain injuries⁶, the clinical standard remains the Glasgow Coma Scale⁷, which assesses a patient's level of consciousness, and employs a mild-moderate-severe classification system. The incidence of moderate to severe TBI can be tracked epidemiologically, however 80% of TBIs are classified as "mild", and the associated costs and incidence are more challenging to capture since most cases do not reach the hospital. "Mild" TBI is also commonly referred to as concussion, and while recent media coverage of sports-related concussion has garnered the public's attention, the vast majority of concussions in North America and Europe (70%) are

caused by motor vehicle accidents and falls. At the same time, "mild TBI" is an oxymoron: it is not 'mild', rather it is a traumatic injury to the most complex organ in the body: the brain. Critically, in a subset of cases, concussion can also result in "second impact syndrome" and death⁸.

An increased understanding of the deleterious long-term cognitive, behavioural, substance use, and mental health effects of repeated head impacts and concussions has been brought to light through recent players' associations litigations in collision sports such as football and hockey in North America. The proper diagnosis, prognosis and treatment of concussion remains an important research challenge, although there is some recent progress in identifying the 10-15% of children who will go on to have post-concussion syndrome or PCS⁹. Currently there are no scientifically validated treatments for concussion (due in large measure to poor control populations and/or baselines, and poor prognostic indicators), but there are many unproven interventions.

In 2012, in an effort to combine resources and focus on improving outcomes and lessening the global burden of TBI by 2020, the European Union, the United States and Canada formed a pragmatic, cooperative consortium of funding agencies called the International Initiative for TBI Research (InTBIR)^{10,11}. The 3 founding members, the Health Directorate of the European Union, the National Institutes of Health's National Institute of Neurological Disorders and Stroke, and the Canadian Institutes of Health Research and other Canadian partners, plus two new members: One Mind for Research (joined in 2015) and the US Department of Defence (joined in 2016), have collectively invested more than \$160m USD since InTBIR's formation. At the fifth annual meeting of InTBIR, held at the Embassy of Canada

in Washington, DC October 11-12, 2016, InTBIR working groups, consisting of clinicians and researchers, reported significant progress in the use of Common Data Elements, Comparative Effectiveness Research, and a priori statistical analyses for the understanding and development of TBI-related fluid biomarkers, genetics, imaging, and outcome assessment.

“An increased understanding of the deleterious long-term cognitive, behavioural, substance use, and mental health effects of repeated head impacts and concussions has been brought to light through recent players’ associations litigations in collision sports such as football and hockey in North America.”

The power of these efforts will be significantly enhanced by this international collaborative in data sharing and advanced analytics, critical for developing a more precise classification system and a personalised medicine approach for TBI. Data sharing will be essential and will accelerate global improvements in outcome by making it possible to compare research findings across multiple health care settings and patients of various ages and ethnicities to determine which treatments are effective and for whom. InTBIR is breaking new ground in identifying resources for data archiving and analytics that adhere to local and international rules and regulations. This is particularly challenging given the various stages of development and evolution of data science policies in various countries. Data curation of highly granular, multimodal data is another essential, and the InTBIR teams of scientists are working to develop quality assurance measures to address this need. A major publication in the Lancet Neurology in the spring of 2017 will address the collective global efforts to date, and a summary report on the fifth Annual Meeting of InTBIR will be available on the InTBIR website in January 2017 (<https://intbir.nih.gov>).

Never before has there been such a concerted effort to lessen the global burden of TBI, and despite the challenges, InTBIR outperforms expectations and demonstrates the power of international collaboration. ■

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Living with chronic pain

Barry Ulmer, Executive Director of the Chronic Pain Association of Canada outlines the many challenges faced by people who live with chronic pain...

People living with chronic pain experience significant changes to their physical and psychological health, which often leads to a huge reduction in their quality of life. It is important that they have a management plan in place to help improve their quality of life, so they can actually live life to as full an extent as possible. This means their physician must accept the fact their pain is real and work with them to manage it. In fact, pain affects more people than heart disease, cancer and diabetes combined, yet remains largely ignored by many in the medical community.

“There are 2 main types of pain: nociceptive pain and neuropathic pain. Alternatively, pain may be classified according to the duration of the pain, as acute, chronic or breakthrough pain.”

A major challenge to people living with pain is that pain management is not a unified field, and care is often not coordinated or even available. There are a number of providers who treat pain, from primary care, to interventionists, to psychiatrists, to chiropractors, and others. Each profession has different training, focuses on different areas, and different approaches to treating pain. For example, a primary care physician may rely on prescription medication as a first-line therapy in addressing pain, but may or may not be familiar with the intricacies of dosing, or have experience in the management of chronic pain. This should not be surprising as research shows most physicians receive little training on the subject as they progress through medical school. In fact, in Canada, veterinarians receive far more training on pain than medical doctors do. A psychiatrist may offer an anti-depressant combined with therapy, and so it goes with all disciplines based on what their discipline indicates. Nothing is coordinated. Typically the care that a person receives is



based on a random selection process of providers, which is costly to our health care system and often benefits are limited.

All this leaves the pain sufferer frustrated and isolated. It reduces their quality of life even more with greater impact on their daily lives and stops them from taking part in activities they normally would. In turn, this has an effect on the psychological health of them as they try to deal with changes this brings. It is common for people in pain to feel frustrated or angry, particularly when they are unable to participate in normal everyday life. This stems their social life and many may have difficulty creating and maintaining relationships with loved ones.

To address some of these issues, it is important that people have the resources to enable them to access a strong support network where they feel comfortable to talk about and work through any issues. However,



these resources for peer groups are extremely limited causing the pain sufferer to become more isolated.

“...pain affects more people than heart disease, cancer and diabetes combined, yet remains largely ignored by many in the medical community.”

There are 2 main types of pain: nociceptive pain and neuropathic pain. Alternatively, pain may be classified according to the duration, as acute, chronic or breakthrough pain. Nociceptive pain is the normal response of our body to potential harm and serves to help protect us from dangers that are encountered. It may be acute or chronic in nature. Neuropathic pain is caused by an injury to the nerves involved in the propagation of electrical signals that send messages of pain to the brain. This pain is often described as a sharp, shooting pain and may be quite intense. Acute pain is pain that alerts us to an injury and can vary in intensity. Chronic

pain continues longer than acute pain and is often defined as any pain that lasts 12 weeks or longer.

At any rate people in pain continue to be the most stigmatised and forgotten people within our communities. Pain is expensive to our health care systems, but the cost of pain in humanistic terms (e.g. loss of jobs, relationships, concepts of self and even life itself) is incalculable. ■

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Protecting victims of crime in Canada

Adjacent Government highlights how the Ministry of Justice in Canada is helping to minimise trauma to children involved in criminal cases...

The law affects many aspects of our everyday lives, no matter what country you live in. Wherever in the world we are, there are laws in place to keep us safe and ensure we follow the right paths. The justice systems are there to ensure our safety and protection from criminal activity.

In Canada the Ministry of Justice is responsible for ensuring the justice system throughout the country is fair, accessible and efficient. The Department represents the government in legal matters, with the current Minister of Justice being Jody Wilson-Raybould.

In Canada, the Department of Justice and the government know the importance of support for victims. As well as making sure that laws are followed and justice is fair, the Department has a role to play in support and protection to victims of crime.

In order to further boost this support to victims, the Honourable Jody Wilson-Raybould [announced funding](#) of €3,411,450 over 5 years to enhance and support services to victims and survivors of crime in British Columbia.

The funding is expected to be used for projects to help advance services and access for justice for victims and their families. These projects will improve services to family members of homicide victims, child victims, victims of domestic violence, victims in remote communities and Aboriginal communities.

Commenting on the funding the Honourable Jody Wilson-Raybould said: "Responding to the needs of victims and their families helps to reduce devastating consequences of crime, not only for victims but for society at large.

"It is important that all levels of government work together to ensure that victims of crime have the services they need and can access the justice system."

The justice system can be challenging, and when children are involved, either as victims or criminals, it can be even trickier. Protecting children that are involved in criminal cases is paramount in order to prevent any kind of long term impact.

The Ministry of Justice in Canada reports that "over the last decade, an increasing number of studies have examined the extent which children's memories are susceptible to suggestion, as a result of post event information.

The [Ministry of Justice states](#): "There have been a proliferation of studies on the suggestibility of children's memories. The findings are at times contradictory and confusing, but several consistent results are appearing. Children are more suggestible than adults and younger children are more suggestible than older children.

"There are interview characteristics such as number of interviews, style of questioning employed in interviews (open, repeated, exploratory, direct, probing, misleading, forced choice and yes-no), emotional tone of interviewer, and social pressure that appear to affect the accuracy of the response's given by children about events they have experienced. Post event information prior to the investigative interview is another factor, which can affect children's reports."

[Child Advocacy Centres \(CACs\)](#) in Canada are a way to help minimise induced trauma to children involved in criminal cases. Their aim is to provide a single, child-friendly setting for young victims or witnesses



and their families to seek services. Funded by the Victim's Fund, CACs are said to greatly reduce the emotional and mental harm to child and youth victims involved in the criminal justice system.

“The Ministry of Justice in Canada reports that “over the last decade, an increasing number of studies have examined the extent which children’s memories are susceptible to suggestion, as a result of post event information.”

In 2015, the Canadian government, as part of their Economic Action Plan 2015, provided additional funding to CACs and child and youth advocacy centres (CYACs). From 2016 to 2017, the government aims to provide \$5.25m over 4 years, and \$2.1m on an annual basis thereafter. This funding is expected to help make support services that are provided by these centres more accessible to communities across the country.

Speaking in 2015 about the funding, Robert Goguen, Parliamentary Secretary to the Minister of Justice and Attorney General, said: “Our government is committed to standing up for victims of crime and giving them a more effective voice in the criminal justice and corrections systems.” ■

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Children's allegations of sexual abuse

One thing I have learned after conducting over 2 decades of research, is that one can never assume anything about children's memory. In fact, I began work in this field precisely because I was hearing lots of opinions in the legal system about children's memory that did not fit with what I learned during lectures on child development. In these lectures, the common theme was "Isn't it incredible what children can do?" whereas commentators in the legal system focused on what children cannot do. Yet, decisions in child sexual abuse criminal cases often hinge on people's assumptions about children's memory. Jurors, judges, prosecutors, police officers, social workers, parents and so on, can influence the case based on their opinion of what children should and should not remember. Some common myths are sexual abuse is so traumatic children would remember it if it happened, interviews need to be done in 10 minutes as children have short attention spans, and children routinely confuse fantasy and reality. Through funding from national research councils, I and students in the Child Memory Lab have tested this last assumption to determine whether it is true or a myth.

This assumption has been cited in legal cases for a long time. I conducted a simple experiment with Dr Mark Blades (University of Sheffield) in 1995. We asked children to hide some buttons in a room and just pretend to hide other buttons. We later asked them where they had hidden the buttons

and found that 3- and 4-year-olds were quite confused about buttons they had actually hid and those that they had merely imagined hiding. However, when I put them back in the room and asked them to go only to where they had actually hidden the buttons, their accuracy shot up, and 6-year-olds were even as accurate as adults. This study taught us that children may appear deficient on the surface but when we modify tests to be more developmentally-appropriate (letting children search for the buttons), we allow children to use their skills appropriately.

Over the next decade, researchers began to realise that there are many sources of information (in addition to children's own imagination), that can contaminate children's testimony. Police investigators are often concerned about informal interviews by parents and concerned adults, whether children have seen similar events on television, talked to other alleged victims, and so on. We have shown, in the Child Memory Lab, that anyone (child or adult) can be confused about the sources of information they recall ('Did I send the email or just imagine sending it?'; 'Did Jan or David tell me about the new job?'). Source confusion is most likely when the sources are similar, when memories of the events have faded, and when information comes from a credible or knowledgeable source. Unfortunately, these are often the conditions children have experienced before they disclose that they have been abused. Consider,



Kim P Roberts PhD, Professor

for example, a child who has been abused for many years (similar, repeated events), takes a long time to disclose the abuse (memories have faded), and a well-meaning parent has unknowingly suggested that the abuse was 5 years ago, when it was actually 2 years ago (credible source).

I have spent the last decade with my students and collaborators developing techniques to reduce contamination from outside sources. It has not been an easy road. Very young children (aged 3 and 4 years old), often do not even understand that someone can believe something happened but be mistaken in that belief. Children aged 6 to 10 have trouble inhibiting (purposefully not thinking about) information from another source. Pre-teens (aged 10 to 12) are able to monitor multiple sources of information but do not necessarily do so.

PROFILE



My strategy has been to a) highlight that there are other sources of information, b) teach children to compare different sources, and c) give practice in monitoring sources and their corresponding information. In some recent studies conducted with Dr Martine Powell and Dr Sonja Brubacher (Deakin University, Australia), we have found we can 'warm up' children by asking them to describe 2 instances of a repeated event (e.g., swimming lessons, weekly visits to grandparents), before discussing the abuse allegations. The warm up provides an opportunity for interviewers and children to develop rapport and, importantly, allows the child to realise that their memories contain information from different sources (in this case, other instances of an event). When the actual topic of the interview is then discussed, children inform interviewers early on if

there has been more than one event, and report more information than children who practised describing just one instance.

It is essential that researchers have appropriate funds to carry out this research. It takes several years and multiple studies to develop a training technique like the repeated-event training just described. It is necessary to test the technique with children from age 3 to teenagers, to carefully observe whether children report more information, to check that the technique does not harm the accuracy of children's memory, and conduct feasibility studies so that the technique can easily be used in the field by investigative interviewers. It is only through meticulous research like this that we can gather objective evidence of children's skills and when they develop, rather than

simply relying on inaccurate assumptions about children's memory. Arguably, this will reduce false convictions and increase true convictions providing better justice and protection to child victims of abuse. Through this research, everyone wins.



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Why monitor water quality?

Donna N. Myers, Chief of the Office of Water Quality at the U.S. Geological Survey highlights the importance of monitoring water quality to better protect human health and the environment...

Water quality is defined as a measure of the physical, chemical, biological, and microbiological characteristics of water. As shown in the following 2 examples, monitoring water quality provides empirical evidence to support decision making on health and environmental issues. In the United States, an emphasis is placed on monitoring for compliance with the Clean Water Act and Safe Drinking Water Act, which are administered by the U.S. Environmental Protection Agency (EPA). Responsibilities for water-quality monitoring are spread among many Federal, State, and local agencies. The U.S. Geological Survey (USGS) is a Federal non-regulatory science agency with water-quality monitoring, assessment, and research responsibilities.

Monitoring water quality in the 21st century is a growing challenge because of the large number of chemicals used in our everyday lives and in commerce that can make their way into our waters. Methods of chemical analysis and knowledge of chemical toxicity are available for only a few thousand of the more than 80,000 chemical compounds estimated by EPA to be in commercial use in the United States.

An example of why we need to monitor for many more chemical compounds than our current capability allows is illustrated by the spill of a little known coal-processing chemical, 4-Methylcyclohexanemethanol (MCHM), into the Elk River in Charleston, West Virginia, USA on January 9, 2014. The Elk River became contaminated by a leaking storage tank containing MCHM, located about 2.4 kilometers upstream from the public water-supply intake for the City of Charleston. River water contaminated with MCHM was drawn into Charleston's water supply system leaving over 300,000 people and area businesses without water for several weeks. "Researchers had little information on how the

spilled chemicals moved through water, their stability or toxicity, or even how to measure them, as published information was either limited or non-existent." said Dr. Bill Foreman research chemist at the USGS.

At the USGS National Water Quality Laboratory (NWQL) near Denver, Colorado, USA a strategy is in place to focus new methods research and development on priority chemical compounds – those that are widely used, persistent, and of potential health concern. Using one of the new methods, MCHM and methyl 4-methylcyclohexanecarboxylate, a previously unreported compound, were detected for at least 6 weeks in contaminated water samples collected by USGS and analysed at the NWQL. All detections of MCHM from the Elk River, from other affected downstream rivers, and in tap water samples were below levels of concern established by health agencies. The USGS traced the chemicals over 630 kilometers downstream from the spill site. The compounds traveled farther and persisted longer in the environment than anticipated. The Elk River spill influenced the U.S. Congress to pass the Frank R. Lautenberg Chemical Safety for the 21st Century Act. The Act, which was signed into law on June 22, 2016; revamped the 1976 Toxic Substances Control Act providing mechanisms to better manage new chemicals and those already in commercial use.

Another example of why we need to monitor water quality is the case of corrosive water, one of the underlying causes of lead in drinking water in Flint, Michigan, Washington, D.C. and other cities. This example illustrates how well-designed monitoring programs can serve current and future needs even if future needs are not foreseen. The USGS has been consistently collecting baseline measurements of ground-water quality for decades to serve a multitude of purposes. Recently these measurements were quickly retrieved from the



USGS computerised National Water Information System (NWIS) to calculate an index of corrosive water that describes the susceptibility of plumbing to leach lead into untreated water.

Results from 27,000 ground-water sites retrieved from NWIS show that more than half the sites in 25 states contain potentially corrosive water, as may occur in homes dependent on untreated water from private wells. Private wells are not regulated under the Safe Drinking Water Act and well owners are not required, except in some jurisdictions, to test their water. The assessment shows areas of the United States that are most susceptible to lead contamination from plumbing due to the use of untreated corrosive ground water. The study demonstrated that an index of corrosive water, calculated from a wealth of readily available and reliable monitoring data, can inform private well owners where further water testing and treatment might be needed to protect human health.

Why monitor water quality? Monitoring provides the objective evidence necessary to make sound decisions on managing water quality today and in the future. Water-quality monitoring is used to alert us to current, ongoing, and emerging problems; to determine com-

pliance with drinking water standards, and to protect other beneficial uses of water. Assessments based on monitoring data help law makers and water managers measure effectiveness of water policies, determine if water quality is getting better or worse, and formulate new policies to better protect human health and the environment. ■

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Creating climate solutions for agriculture and forestry

Adjacent Government Editor, Laura Evans speaks to Rachel Steele, National Climate Hub Coordinator at the U.S Department of Agriculture about how they are helping to reduce the impacts of climate change for farmers and foresters...

Agriculture plays a key role in society worldwide. Seen as the backbone of the economic systems of most countries, it not only provides necessary sources of food and fiber, but also offers emerging economic opportunities in renewable energy, broadband, and recreation. Climate change presents real threats to agriculture, in regards to production, forest resources and rural economies. As the risks of climate change are becoming more prevalent, such as more severe storm events, it is increasingly important to help reduce these risks for land managers.

As the world population continues to grow – to an estimated 9 billion people by 2040 – farmers will have to feed not only the U.S, but the rest of the world. To help farmers adapt to a changing climate, the U.S. Department of Agriculture (USDA) is working on solutions to build resilience to climate variability. Rachel Steele, National Climate Hubs Coordinator at USDA, talks to Adjacent Government Editor Laura Evans about the problems climate change causes for agriculture and the Department’s solutions.

“Climate Change is having profound direct and indirect effects on agriculture with considerable regional variance,” explained Steele. “Some of the direct effects include: increased annual average and seasonal air temperatures; increased extreme precipitation events as well as increased risk of damage to crops, soils, and infrastructure; flood damage is expected to increase; severe wind and storm damage, and warmer temperatures increase the potential for soil moisture stress and drought.

“Indirect effects include: greater weed pressure increases the risk of crop loss; invasive weed competition may increase in pastures, orchards, and other perennial agriculture; populations of many damaging

insects may increase; the risk of plant pathogens may rise, and animals may be affected by heat stress as well as increased pathogens and parasites,” she said.

USDA is trying to make sure farmers have all the information and tools they need to deal with these effects. For example in February 2014, Agriculture Secretary Tom Vilsack launched the USDA Climate Hubs. When doing so he emphasised, “for generations, America’s farmers, ranchers and forest landowners have innovated and adapted to challenges. Today, they face a new and more complex threat in the form of a changing and shifting climate, which impacts both our nation’s forests and our farmers’ bottom lines.”

The Regional Climate Hubs were established to synthesise and translate climate science into easy to understand information and tools, so that land managers can make climate-informed decisions.

Steele explained, “[The Climate Hubs](#)” work across USDA agencies and through established networks of partners on the ground to transmit information to technical service providers. USDA has the advantage of having an extensive network of staff and partners, such as Natural Resources Conservation Service (NRCS) regional staff, University Extension Agents, Certified Crop Advisers, seed dealers, Farm Service Agency (FSA) agents, and other trusted regional partners. “The Hubs are focused on building climate literacy “in-reach” to USDA staff and “outreach” via regional trusted channels and partners. The Hubs are synthesising the science, producing the tools and ensuring that these existing regional partnerships and networks have a good understanding of what climate change means for them at the local level and at the seasonal time-scale. Farmers are business managers, they need to have the best available information and tools to manage risk

and understand what different decisions will mean for their land. The Hubs are working across the country to ensure that they have this information available to them.”

The Hubs have been effective in their first 2 years of existence. A few of the many developments include: writing eight regional vulnerability assessments; synthesising the forest service drought synthesis report; developing a Climate Hubs tool shed, which is an inventory of tools for working land managers; establishing strong regional partnerships with private, federal entities, and University/Extension partners.

“We’ve developed adaptation handouts, videos, fact-sheets, email alert systems, tools, and also a close working partnership with other federal agencies’ climate networks, such as the Department of Interior’s Landscape Conservation Cooperatives, Climate Science Centers, and National Oceanic and Atmospheric Administration (NOAA) Regional Integrated Sciences and Assessments (RISA), who have regional climate networks as well. We linked up with them to really build on their climate knowledge and information to make sure it gets to the people that need it.”

In addition to the regional Climate Hubs, USDA launched The Building Block for Climate Smart Agriculture a year ago. This initiative represents a comprehensive and detailed approach to support farmers, ranchers, and forest land owners in their response to climate change. The framework includes a road map that outlines progress, implementation plans and case studies for the 10 building blocks. These 10 building blocks span a range of technologies and practices to reduce greenhouse gas emissions, increase carbon storage, and generate clean renewable energy. The building blocks include: soil health; nitrogen stewardship; livestock partnerships; conservation of sensitive lands; grazing and pasture lands; private forest growth and retention; stewardship of federal forest; promotion of wood products; urban forests and energy generation and efficiency.

“Working through existing programs and authorities, USDA is committing to reduce over 120 million metric tons of CO₂e per year by 2025,” said Steele. “These building blocks are voluntary and incentive-based; focused on multiple economic and environmental

benefits, designed to meet the needs of producers, and measured to evaluate progress.

“The USDA climate hubs have been communicating the building blocks at the regional level providing the latest information and research on the various technologies involved in the building blocks, and providing information about their effectiveness at the regional level. In addition they have been bringing USDA agency staff to the table to discuss climate change and opportunities/barriers as we mitigate emissions and facilitate climate smart agriculture.”

“Climate change presents real threats to agriculture, in regards to production, forest resources and rural economies. As the risks of climate change are becoming more prevalent, such as more severe storm events, it is increasingly important to help reduce these risks for land managers.”

Research is a key part of the work that USDA is doing in order to provide information for farmers and landowners. As part of the work at the Regional Hubs, it’s important to be able to communicate the research and information that they receive from these programmes.

“The Climate Hubs not only communicate the research and information that’s coming out, but also take back information from the farmers to the research entities” said Steele.

Looking ahead, the Climate Hubs will continue to focus on partnership building, climate literacy “in-reach” and out-reach, capitalising on regional synergies to communicate climate science, developing tools, conducting assessments, and using innovative strategies to share adaptation and mitigation demonstrations with working land managers. ■

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A Global Perspective on Agriculture Research

The USDA National Soil Dynamics Laboratory (NSDL) has a long history of research on developing sustainable agriculture. Originally founded as the Farm Tillage Machinery Laboratory in 1933 on the Auburn University campus in Auburn, Alabama, USA, it was initially charged with researching tillage, associated traction practices, and machines used in cotton production. The lab was instrumental in the development of engineering principles for modern agricultural equipment design. Currently, NSDL's mission is to develop tools, practices, and products to better manage soil for environmentally sustainable and economically profitable agricultural production systems. While the research is centered around Southeastern USA production systems, implications of findings clearly have a more global prospective, especially in the context of efforts to understand how agriculture influences global change.

The Laboratory solves agricultural problems in three major areas:

- Conservation systems;
- Organic waste management; and
- Global change.

Specific objectives include developing conservation systems that reduce drought risk and sequester soil carbon, developing environmentally sound waste management systems, and determining the effects of atmospheric CO₂ levels on above- and below-ground processes that affect crop



production, soil carbon storage, and trace gas emissions.

Currently, there are many uncertainties concerning agriculture's role in global environmental change including the effects of rising atmospheric CO₂ concentration. Agricultural practices have the potential to increase soil C storage which can positively influence soil quality and help mitigate this rise in atmospheric CO₂. Research at NSDL is examining the effects of atmospheric CO₂ on both biomass production and soil C sequestration.

The concentrations of trace gases (nitrous oxide and methane) in the atmosphere are also increasing with agriculture being a primary contributor. The NSDL has a multi-disciplinary research team investigating ways that agriculture can help reduce greenhouse gas (GHG) loss through improved practices and fertiliser use in cropping and horticulture systems. This work is evaluating new, innovative application techniques that reduce

GHG emissions, including determining fertiliser N use efficiency and fate of fertiliser N in these systems as well as changes in C and N cycling processes. This work showed that soil C storage is sensitive to soil N dynamics and that the decomposition of plant material grown under elevated CO₂ depends on crop species and indigenous soil properties. It has also led to a US patent on the use of microbial inoculations to reduce nitrous oxide emissions from fertiliser N application (US9,266,786 B2).

Research at NSDL develops conservation systems that improve soil quality, conserve natural resources, and increase production efficiency by considering input costs and profitability. A major focus is to evaluate the use of alternative fertiliser sources, such as poultry litter (a poultry manure and bedding material mix), compared to commercial fertiliser in tillage systems designed to enhance soil organic matter accumulation, crop productivity, and grower profitability. Application of

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poultry litter to soil can improve soil conditions and provide nutrients needed for plant production. This seems to be a viable option for South-eastern USA producers due to rising costs of inorganic fertilisers and the fact that the growing poultry industry generates large amounts of manure. Field and laboratory studies are being conducted to develop improved methods to utilise waste products for soil and crop benefits while minimising environmental degradation since improper manure application can increase hypoxia, eutrophication of surface waters, human health

problems, and GHG emissions. Furthermore, using poultry litter in conservation agricultural systems could sequester atmospheric C in soil. Research has shown that the use of poultry litter in long term research plots resulted in increased soil C levels and thus higher atmospheric C sequestration. However, best management practices must be developed for poultry litter application that maximises nutrient uptake and minimises GHG loss.

Tillage and fertilisation practices used in row crop production can alter GHG

emissions from soil. A new prototype implement for applying poultry litter in subsurface bands in the soil was used in studies to determine the impact of management practices and fertiliser source and placement methods on GHG emissions. As part of this effort, a new method was developed for calculating Effective Gas Flux from soil following band application of manure or fertiliser. Banding of fertiliser resulted in the greatest concentration of gaseous loss compared to surface application and conventional tillage resulted in a higher concentration of CO₂ and N₂O loss. These results suggest that poultry litter can be used to sequester soil C, but application by banding has the potential to increase GHG emissions.



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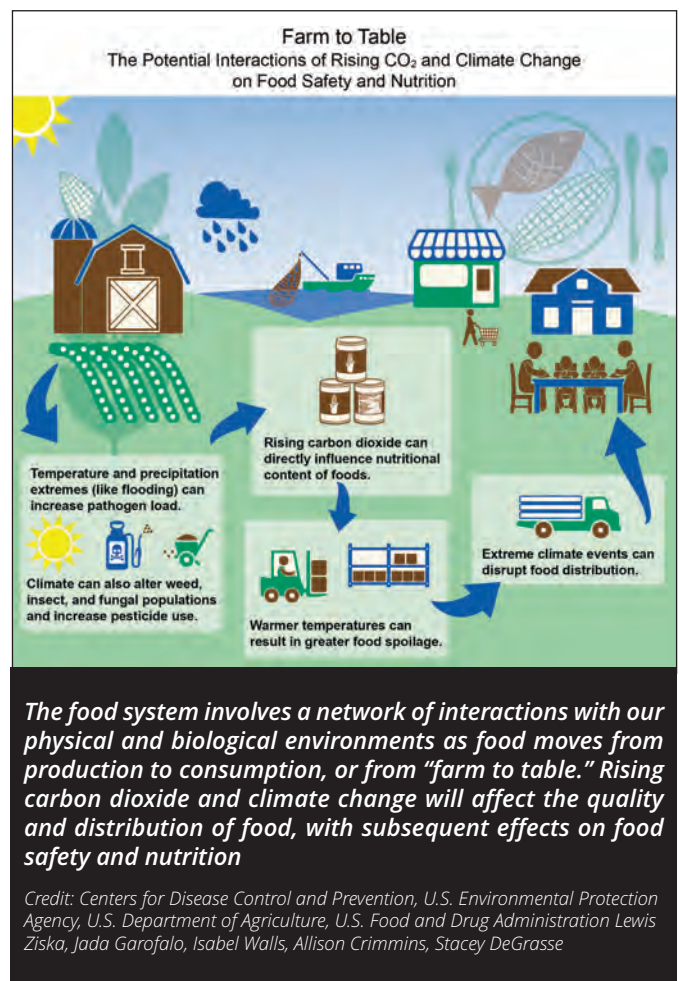
Protecting our food system in a changing climate

Dr. Stephanie Pearl, Science Communicator at the USDA National Institute of Food and Agriculture, highlights a number of food safety measures and how these are integral in an ever changing climate...

A major challenge to our food system is feeding a growing population that is projected to exceed nine billion in just the next three decades. This challenge requires both increasing food production and protecting the safety of our food supply in the face of a changing climate and diminishing land and water resources.

According to a [recent report by the US Global Change Research Program](#), rising atmospheric and ocean temperatures are expected to increase the exposure of food to certain pathogens (disease-causing bacteria, fungi, viruses, and small parasites). For example, significantly warmer coastal waters in Alaska from 1997 to 2004 were associated with an outbreak in 2004 of *Vibrio parahaemolyticus*. This bacterium is one of the leading causes of seafood-related gastroenteritis ("food poisoning") in the United States and is associated with the consumption of raw oysters harvested from warm-water estuaries. Air temperature also affects pathogen levels of multiple species of *Vibrio* in shellfish. For example, *Vibrio vulnificus* may increase 10- to 100-fold when oysters are stored at ambient temperatures for 10 hours before refrigeration, potentially necessitating changes in post-harvest controls to minimise the increased risk of exposure.

To mitigate such threats, researchers are developing methods for predicting and detecting the emergence and preventing the spread of harmful microorganisms such as *Vibrio* species. A team based at the University of North Carolina at Chapel Hill and funded by the U.S. Department of Agriculture's National Institute of Food and Agriculture (NIFA) is developing models that will help seafood producers predict when the public will be at increased susceptibility to foodborne illness from oysters and other shellfish. Other research groups are beginning to use DNA sequencing technologies to



rapidly and affordably identify which microbes are present on the surface of foods. For example, NIFA-funded researchers at the University of New Hampshire have developed [a new screen that is based on a set of genetic markers that should improve detection and surveillance of *V. parahaemolyticus* in seafood.](#)

Extreme weather events, such as drought and flooding, may also increase the risk of food exposure to pathogens. Drought can increase the concentration of pathogens in water that is used for irrigation, livestock management,



A Washington State University-led research team member works on the prototype microwave assisted pasteurization system (MAPS) unit. MAPS allows packaged foods to be safely processed more quickly and at lower cost than conventional processes

Photo courtesy of Washington State University

food handling, or storage. Intense bursts of heavy rainfall may lead to flooding, potentially contaminating this water supply with other waters that carry sewage, manure, or other foodborne contaminants. A NIFA-funded research team based at Colorado State University is trying to understand the specific conditions that favor the production of cyanotoxins by certain classes of cyanobacteria that can exist in agricultural ponds. Cyanotoxins are responsible for animal poisonings in a majority of the United States and more than 50 countries globally. Surface temperatures of water have increased due to climate change, leading to a higher frequency of these toxic algal bloom occurrences.

Increased average temperatures and humidity can also increase the prevalence of molds that produce toxic chemicals such as mycotoxins. Prior to harvest, warmer temperatures and drought can stress plants, making them more susceptible to mold growth. Warm and moist conditions favor mold growth and affect the biology of insects that transmit molds to crops. If crops are not dried and stored at low humidity, mold growth and mycotoxin production can increase to very high levels. Once introduced into the food chain, these poisonous toxins can lead to acute and chronic health issues.

Consumer education is a critical piece to ensuring a safe food supply. NIFA-funded researchers at Kansas State University and Tennessee State University found that bagging poultry at the meat counter in grocery stores can reduce the spread of bacterial contamination of other food items, the grocery cart, people, and refrigerators. The same research team also emphasises the importance of using a thermometer to check the doneness of cooked meat. Many kitchens are lit by energy efficient lights that often make meat appear more cooked than it actually is, making visual inspection no longer a reliable test for doneness.

In addition, to protect our food supply from contamination while maintaining the quality of ready-to-eat meals, NIFA-funded researchers at Washington State University have developed microwave-assisted thermal sterilisation (MATS) and pasteurisation systems (MAPS). These systems use a combination of microwave heat and hot water to rapidly heat and briefly hold packaged food at sterilisation or pasteurisation temperatures before quickly cooling the food. These systems currently operate at several locations around the United States, and major consumer food companies in Singapore and India have recently purchased the systems.

Taken together, rising global temperatures and changes in weather extremes are likely to increase the exposure of food to certain pathogens and toxins. It is therefore increasingly important to implement practices that will protect the safety of our food. ■

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Can metals replace traditional antibiotics?

Raymond J Turner and colleagues at the University of Calgary, consider the future of metals as replacements for traditional antibiotics...

The prophylactic use of antibiotics in the agricultural industry is considered one of the key contributors to the widespread emergence of antimicrobial resistance (AMR). A number of mitigation strategies have been proposed to address this problem, including discontinuing the administration of preventative antibiotics in livestock, enhancing the monitoring process for emergence of antimicrobial resistant organisms, and controlling the practice of antibiotic misuse by offering alternative antimicrobial strategies. To that end, our research group at the University of Calgary is examining the capacity of an array of metal formulations – with proven antimicrobial activity – as alternative options to conventional antibiotics and antiseptics.

A surge of societal awareness regarding practices in food production has generated a call for ‘organic’, antibiotic, and hormone-free foods. Unfortunately, this social movement falls short in addressing the issue of antibiotic resistance as the practices inflate the cost of food production; encouraging the perpetuation of the aforementioned agricultural practices in poorer nations. Consequently, the need for alternative strategies to combat infectious disease is ever present.

Prior to the 21st century, studies into the mechanisms of bacterial resistance to metal ions and so-called ‘heavy metals’, was the realm of a few

dozen scientists globally. In fact, less than 50 manuscripts per year were published on this subject despite the use of metals as antimicrobials for thousands of years. Upon recognition of multidrug resistance in clinically-significant bacterial strains, the scientific community saw a surge in the number of publications in the field of metal-based antimicrobials. Their use is now pervasive, and has continued to increase since 2010.

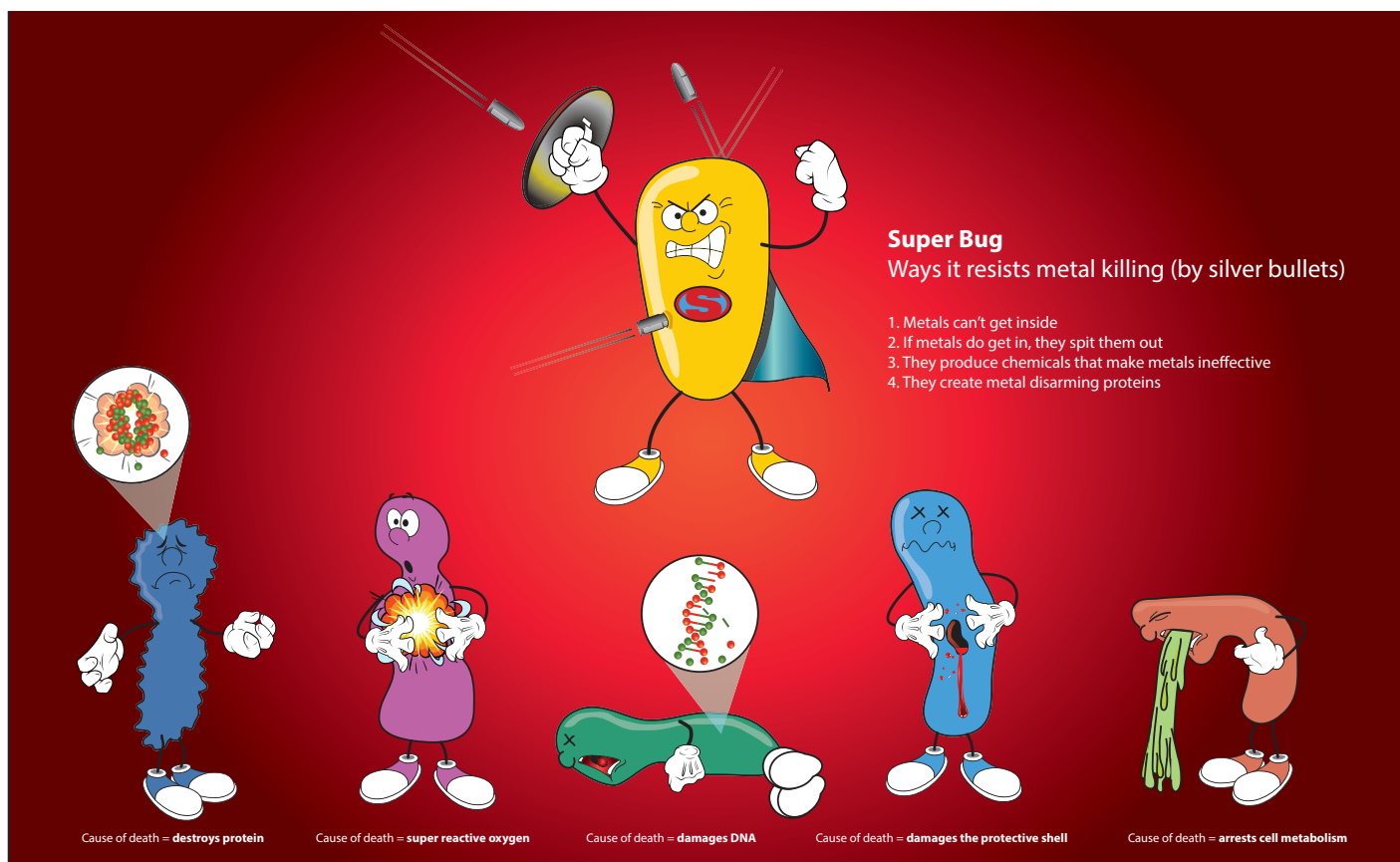
For decades researchers have explored bacteria’s ability to resist toxic metals and, as a result, a number of genes responsible for conferring metal resistance have been revealed. While no single mechanism is solely responsible for bacterial metal resistance, several simplified mechanisms can be distilled from the body of knowledge that has been generated from monitoring how bacterial physiology changes in the presence of toxic metals. The mechanisms of metal toxicity are even less understood compared to those of metal resistance in bacteria and other microorganisms. Nonetheless, several pathways have been extrapolated from recognised mechanisms of metal toxicity.

New, re-emerging, and recurring community-acquired and nosocomial pathogens that are antibiotic resistant are now universal. Antibiotic development pipelines are dry. Hence, the enhanced appeal of using metals as antimicrobials. We, and others, have

shown that metals demonstrate the capacity to be very effective at killing microorganisms at low concentrations. The use of these compounds has progressed past clinical trials and into consumer products. They can now be found in wound dressings and other medical devices, as well as liquid formulations for hand washing, and impregnated into textiles. It’s noteworthy to mention – and perhaps not entirely surprising – that silver resistant bacteria have already emerged in the clinic.

In the agricultural industry, metals are used as antifungal seed dressings, pesticides, wood preservatives, and as animal feed additives. In fact, several countries have begun to substitute the use of traditional antibiotics with metal compounds, such as copper and silver. On the surface, this strategy has the appearance of being efficacious. Yet, their unchecked use considerably increases metal deposition in soils and water bodies, notably modifying microbial communities and the surrounding ecosystem. Recent research has noted that studies of soil microbes exposed to metals became ‘primed’ for increased transmission for antibiotic resistance determinants, even though they have not been previously exposed to antibiotics. Additionally, our research group has demonstrated that metal efficacy against bacteria is difficult to predict, as a result, blanket treatments are dangerous and should be avoided or

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applied with caution. To that end, we cannot help but ask ourselves if we are taking two steps backwards after our perceived step forward. With this in mind, we need to be aware that replacing conventional antibiotics with antimicrobial metals may encourage a more intricate problem if their use is loosely controlled.

What is evident is that determining the direct and subsequent downstream effects of metal exposure is not a trivial task. For over a decade, our Microbial Biochemistry Laboratory at the University of Calgary has concentrated on understanding these challenging questions. We have broadened our metal research to a number of pathogenic microorganisms, and intend to further expand this work. After each experiment, we are ever closer to uncovering the precise details of how each type of metal exerts its antimicrobial effects. Still, a considerable amount of work is required, limited only by lack of interest in funding such research.

Strategies to curb antimicrobial resistance include: Stewardship over the use of antibiotics; reduction in the use of all antimicrobial agents – in human and veterinary medicine, household and institutional settings, agriculture and industry; and increasing public awareness about steps to take to thwart antibiotic resistance.

Lastly, it is necessary to recognise that the status of antimicrobial resistance is an intricate problem and requires influence and insight from politicians, physicians, veterinarians, and industrial stakeholders. Before the use of novel antimicrobials (such as metal-based compounds) is approved, it is imperative that we equip ourselves with solid scientific evidence that informs on the mechanisms of both toxicity and resistance in microorganisms. In this manner, we can establish a framework for their responsible use and potentially extend their utility as antimicrobial agents – an opportunity we squandered with conventional antibiotics.



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Funding key research for Alzheimer's disease

Melinda Kelley from the National Institute on Aging in the US, speaks to Editor Laura Evans about raising awareness of Alzheimer's disease and how funding for research is allocated to the National Institutes of Health...

Alzheimer's disease is a global health challenge. The most common form of dementia, Alzheimer's disease, affects an estimated 46.8 million people worldwide in 2015 with that number expected to double every 20 years. In the USA alone, in 2013¹, 5.2 million people – aged 65 years and over – were affected by this condition. It is reported that by 2030, that figure will grow to 8.4 million and 13.8 million by 2050.

The United States' National Institute on Aging (NIA) is one of 27 institutes and centres of the National Institutes of Health (NIH). NIA is at the forefront of research activities dedicated to understanding the nature of aging, supporting the health and well-being of older adults, and extending healthy, active years of life for more people.

Adjacent Government Editor Laura Evans talks to NIA's Melinda Kelley to find out more about the work they do to support research into and raise awareness of Alzheimer's disease.

"What is really critical is the fact that the drugs currently approved to treat Alzheimer's don't really address the underlying disease's process. Most people feel like the really big goal ahead of us is developing either preventative therapies or interventions for people who are living with the disease already."

"There is a lot of information out there. We, as well as some very large Alzheimer's groups in the US and around the world, provide a lot of health information. But people may not be getting the information they need, about how important it is to go to your doctor. At the same time, we are reaching out to health care providers, providing them with assessment tools and clinical trial information. However, I do think people

recognise that the disease is a critical issue for many of us personally and for society in general."

In 2012, [the National Plan to address Alzheimer's disease](#) in the US was unveiled. The Plan's main aim is to address the major challenges presented by Alzheimer's, and it outlines and tracks the various goals and activities involved – from advancing scientific collaboration to improving patient care.

"The NIA, NIH, and the US government are tirelessly working towards their goal of treating or curing Alzheimer's by 2025. However, there are still challenges and hurdles and one of the main challenges is getting people to see their doctor, should they have memory issues."

"The National Plan goes beyond what we do at the NIH and the NIA," says Kelley. "It includes research, but also care and services and there are other parts of the Federal government – as well as non-governmental organisations – here in the US that help address the needs of people with Alzheimer's disease and their families."

"It's not just about the need for future successes in preventing and curing Alzheimer's, because we have lots of people who right now need supportive care and community services. The NIH funds caregiving research, but there are many parts of the Federal government that address care and support issues, and that's all part of that National Plan," Kelley explains.

"But NIH, and in particular NIA, leads the way in making sure the research gets implemented. The main research goal is prevention or intervention for Alzheimer's by year 2025 – which is coming up quickly from a research perspective. Clinical trials can take a number of years –



running the trials themselves and recruiting enough people to take part take time.”

The recent released, US legislatively mandated report – [Stopping Alzheimer’s Disease and Related Dementias: Advancing our Nations’ Research Agenda](#) – is separate from the National Plan. However, it is a US government document – a “bypass budget” – that lays out the NIH’s estimates for the funding needed to implement its research plans, as Kelley explains.

“In 2011 when the initial legislation was signed by President Obama – the National Alzheimer’s Project Act – it made Alzheimer’s more visible and we at the NIA started to see boosts in Federal funding for Alzheimer’s research.”

“Initially, it was a redirection of money from the NIH Director, but by fiscal year 2014 we started to see increased Congressional appropriations – more money from the US Congress – directed to the NIA – to share across the NIH, and then we received a big increase

(\$350mn) in fiscal year 2016, which is the year we are in now.”

“The President puts out a budget each year and Congress decides how much to give us. However, the bypass budget allows the NIH to report, through a separate professional judgement process, how much additional money it would take to reach that goal of treating or curing Alzheimer’s disease by 2025,” Kelley adds.

“We have now presented the second bypass budget for Alzheimer’s disease [the Stopping Alzheimer’s Disease and Related Dementias report referenced above],” she says. “We put out a bypass budget for future fiscal years, but if funding comes “early,” then we have to accelerate the research as much as we can – this is what happened last year.”

As well as research funding, the NIA within the NIH also provides a great deal of information for the public on Alzheimer’s disease. It’s important to raise awareness and reduce the stigma that still seems to be attached

to various types of dementia, including Alzheimer's. One of the major challenges, Kelley agrees, is getting people to discuss memory problems with their doctor.

"I think people are certainly aware of Alzheimer's and know what a huge public burden it is. Everybody knows someone who has had Alzheimer's or one of the related types of dementia – there are a number of Alzheimer's-related dementias, such as frontotemporal dementia, Lewy body dementia, and vascular cognitive impairment/dementia. People know family, friends and others in their community – but there is definitely a stigma," she says.

“What is really critical is the fact that the drugs currently approved to treat Alzheimer's don't really address the underlying disease's process. Most people feel like the really big goal ahead of us is developing either preventative therapies or interventions for people who are living with the disease already.”

"You probably heard about the actor Gene Wilder who died recently. The US press reported that he didn't want anyone to know he had Alzheimer's, so he was a recluse as the disease progressed, because he didn't want to frighten children who might have seen him in some of his roles.

"There is still a stigma attached to the disease and reducing that stigma and getting people who have memory issues to go to their doctor and talk to them is really important. Even though there is no curative treatment available at present, it's important for people to recognise what is happening," Kelley stresses. "There are also things you can do to support caregivers, to give them a break and help affected individuals and their caregivers plan for the future."

Clinical trials are key to understanding the disease further and help with early diagnosis. However, as Kelley explains, getting the numbers of volunteers required for effective clinical trials is one of the many hurdles to get over in order to reach their 2025 goal.

"The challenge of recruitment for clinical trials is looming ahead of us in order to reach that goal in 2025," she says. "It's very difficult to recruit for all clinical trials across the board and for Alzheimer's in particular; we need thousands of people screened. Most critically, we need people to join prevention trials who don't have cognitive impairment or memory issues.

"We want to see people in their 40s and 50s who might be just at the start of the process, as it is believed that the disease starts decades before you have memory problems – with the build-up of the proteins that cause the biological issues. We want to intervene right at the start, before they even visit their doctor with symptoms. We want to test the effectiveness of giving therapy to people at this very early stage of the process. Expanding the recruitment to this stage could be a challenge."

The NIA, NIH, and the US government are tirelessly working towards their goal of treating or curing Alzheimer's by 2025. However, there are still challenges and hurdles. The NIA provides a great deal of information for the public in order to wipe out the stigma and help people to tackle Alzheimer's head on (see: <https://www.nia.nih.gov/alzheimers>). It's about everyone involved coordinating and working together to help fill the gaps. ■

1 https://www.alz.org/downloads/facts_figures_2013.pdf

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Examining the feeding behaviour of *Anopheles darlingi*

Jan E. Conn and Sara A. Bickersmith from The Wadsworth Center, New York State Department of Health, Albany, NY, USA discuss spatial and temporal feeding behaviour in *Anopheles darlingi*: implications for vector control...

Across its broad distribution in Latin America, the main malaria vector *Anopheles darlingi* displays variability in host and feeding time (time of night, seasonality) and place.¹ For example, although mainly anthropophilic (feeds on humans), it will also feed opportunistically on cattle, pigs, horses, dogs² and even Galliformes (Moreno et al. unpub.). Biting times, normally restricted to crepuscular and night-time hours, can be clustered into distinctive peaks, such as early evening, when few people are under bednets,¹ and/or during early morning hours; or can occur at low levels throughout the night, such as in riverine villages in eastern Amazonian Brazil.³

“The variability in *An. darlingi* behavior supports the need for very local entomological data that can help determine for village residents the peak risk times and places of malaria transmission, and how to best supplement the current standard of vector control, which is long lasting insecticidal nets (LLINs) and indoor residual spray (IRS).”

Whether a malaria vector feeds mainly indoors (endophagy) or outdoors (exophagy), or may go back and forth between these behaviours, is influenced by intrinsic and extrinsic factors. Outdoor resting vectors (exophilic) that are mainly anthropophilic, are driven to take a blood meal indoors early



in the evening, when humans are available (not protected under nets).⁴ As this behavioural profile partially fits *An. darlingi*, it could be one explanation for the frequent records of endophagic early evening biting peaks in many endemic regions of Latin America.¹ The fact that this species also frequently feeds exophagically during the evening crepuscular hours may be attributed to the availability of humans who socialise, cook, and work in the peridomestic environment.

In the same populations of *An. darlingi* that demonstrate early evening feeding, some studies have detected a second peak around midnight or 2-3 AM (1,5). This latter peak has been hypothesised to be correlated with a

shortened gonotrophic cycle during the rainy season when the density of *An. darlingi* (and most other mosquitoes) is highest.¹ If such females have laid eggs during the early evening, they could be seeking a blood meal as early as midnight of the same day.⁶ Evidence in support of this hypothesis is lacking, but would consist of dry season *An. darlingi* with a longer gonotrophic cycle and no biting peak around midnight or 2-3 AM. Micro-environmental differences in humidity inside and outside houses were also considered to be potential reasons for higher levels of endophagy during periods of peak *An. darlingi* density.⁶

Alternatively, the *An. darlingi* biting at different times during the night could

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represent distinctive genetic subpopulations, as found in Acre state, western Brazil (Campos et al. unpub.). In our study sites in the peri-Iquitos region of Peru, we detected genetically distinctive subpopulations of *An. darlingi* with consistently different biting patterns.⁷ That is, in the high-way habitat, a unimodal biting peak around midnight consistent with earlier studies was detected;⁸ in contrast, there was a bimodal peak (7-9 PM; 2-3AM) in all riverine habitat localities.

Currently, we are testing some of these hypotheses of spatiotemporal behavioural patterns in *An. darlingi* in riverine villages in the peri-Iquitos region of Amazonian Peru. The variability in *An. darlingi* behavior supports the need for very local entomological data that can help determine for village residents

the peak risk times and places of malaria transmission, and how to best supplement the current standard of vector control, which is long lasting insecticidal nets (LLINs) and indoor residual spray (IRS).

“The fact that this species also frequently feeds exophagically during the evening crepuscular hours may be attributed to the availability of humans who socialise, cook, and work in the peridomestic environment.”

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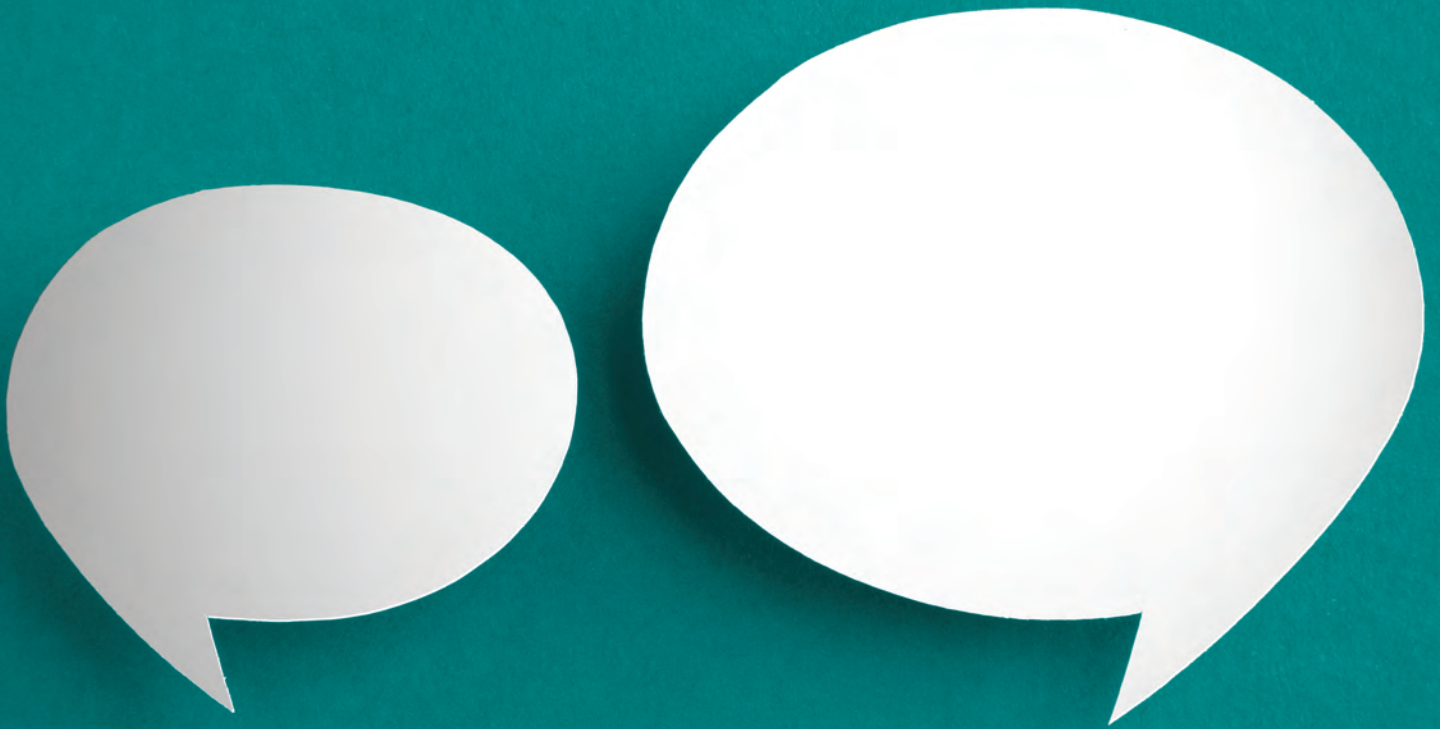


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The reverberating impacts of detecting gravitational waves

Denise Caldwell, Director of the National Science Foundation's Physics Division in the Directorate for Mathematical and Physical Sciences, looks to the future for gravitational wave research...

On February 11, The National Science Foundation (NSF) hosted a press conference to announce that its Laser Interferometer Gravitational-wave Observatory (LIGO) had detected gravitational waves from 2 merging black holes, approximately 1.3 billion light years away. Since that time, this news – which represents a major breakthrough in observing our universe – has not only excited the scientific community; it has transcended pop culture – from Garrison Keillor's *Prairie Home Companion* and Stephen Colbert's late night show to the annual Washington Post peeps diorama contest.

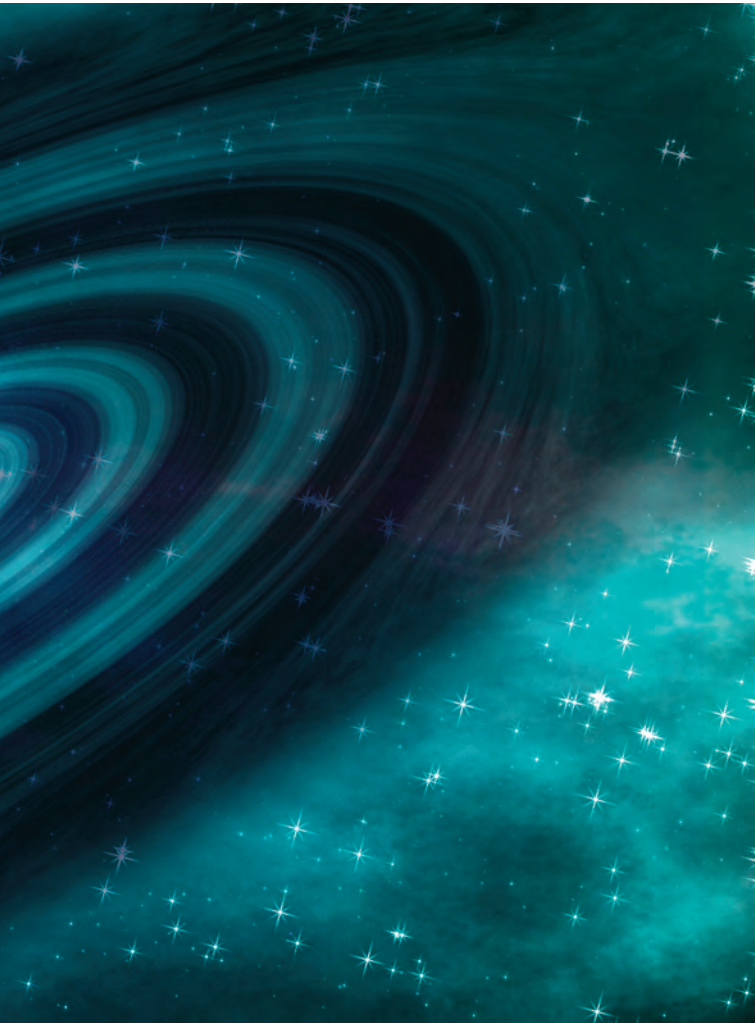
The attention is well deserved, and the tributes that have been paid are intensely gratifying. Not just because the science is so remarkable, but the path to get to this point has not always been so smooth.

LIGO's history reflects notable determination, inspiration and tenacity. It's true, Einstein predicted gravitational waves a hundred years ago, but even he thought detection was likely impossible. However, as Dr. Fleming Crim, our assistant director for NSF's Mathematical and Physical Sciences Directorate noted recently, "the

possibility of opening a new window on the universe was so tantalising that NSF began funding research on prototype laser interferometers in the 1970s. And, in 1994, the agency committed almost \$300m to a group led by Kip Thorne and Ron Drever of Caltech and Rainer Weiss of MIT to transform their prototypes into a full-blown gravitational wave observatory."

For those of us at the agency today, it's hard not to respect the brilliance, vision, enthusiasm, experimental prowess and deep theoretical insights these researchers had, persuading NSF, the National Science Board and Congress to take a risk. Even though NSF had not funded anything on such a scale previously, the potential for transformative science justified such a big commitment. In fact, the agency embarked on a new role by funding this large, high-risk, high-reward research platform. It was basic scientific research with a clear eye toward future possibilities.

While many on the day of the press conference found they might view the discovery as a comfortable landing where one might pause and take in the view, we here



“We have sights on a future of learning even more about the violent phenomena that inhabit these dark corners of our universe.”

Of course, basic research like this provides no promises. And the risk of failure is an ever-present specter lurking in the background. But for those doing the work – as well as those of us who make decisions to fund it – the results can be utterly revolutionary. LIGO may have made international news, but this really is our agency’s daily work: to support science at its earliest stages, being mindful of the long road ahead and being prepared to accept the risk involved. To again quote Fleming Crim, “fundamental science has transformed our world and will continue to change it in ways we have not yet imagined – in much the same way that Einstein’s own theory of relativity is what ensures the accuracy of our GPS or that the same technique used to stabilise LIGO’s sensitive laser frequencies also helps to build the semiconductors in our computers and cellphones.”

Just as in those cases of fundamental science driving innovation forward, we again will keep trying to push the envelope and look toward the future with gravitational wave research. In February, we got to help open a window to our universe that was a long time in coming. Now, we must also be good stewards for ensuring we continue to fund science with the vision to see what’s beyond that window. ■

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at NSF see this as only the beginning of an entirely new subarea of physics and astronomy, the opening of a new window on the cosmos. We have sights on a future of learning even more about the violent phenomena that inhabit these dark corners of our universe.

LIGO is expected to reveal objects out there that no one even knew existed. As the results from LIGO are combined with other observations NSF has fostered over the last decade, we will start to probe the universe closer and closer to its very origin. At the NSF telescope at the South Pole we will, for example, look for the imprint of gravitational waves on the cosmic microwave background, that faint, leftover light from when hydrogen atoms first formed after the Big Bang. At an NSF funded Physics Frontiers Center, scientists studying pulsars will search for indirect evidence of gravitational waves. As these discoveries are combined with measurements utilising electromagnetic radiation and elementary particles, this multi-messenger approach will enable us to paint a more comprehensive picture of this vast cosmos we inhabit.

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Child and Youth Studies (CHYS) is one of the most popular programs at Brock. Students learn from a broad-based approach that considers the individual child or youth within the context of the family, school, peer group and community. With interdisciplinary roots in psychology, education, sociology, cultural studies and criminology, the degree gives academic background to pursue a wide variety of careers or to pursue further studies in a Master's program and the new transdisciplinary PhD program.

CHYS will be hosting a multidisciplinary conference on conceptualizing children and youth October 11-13, 2017.

Watch the CHYS website for more details:

<https://brocku.ca/social-sciences/departments-and-centres/child-and-youth-studies>