

ANNUAL IMPACT REPORT

2014-15

This report is a comprehensive summary of the outputs, outcomes and early impacts resulting from research funded by Alberta Innovates – Health Solutions (AIHS) as reported in 2014-15. This monitoring data is routinely collected by the Performance Management and Evaluation team at AIHS for the purposes of accountability and learning.

Alberta 

Acknowledgments

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Annual Impact Report 2014-15 (Alberta Innovates – Health Solutions)

ANNUAL IMPACT REPORT

2014-15

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EXECUTIVE SUMMARY

Alberta Innovates – Health Solutions (AIHS) is known internationally for the high quality of the health research and innovation activity it fosters and supports through funding and partnerships. These activities lead to better health and wellbeing, improvements in health care and economic diversification in the province. Increasingly, in Alberta and internationally, funders and governments are asking: what results or impacts are we getting from our funding of health research and innovation? How do we know that? And when we do know the impacts, how do we make best use of them?

The answers for AIHS are clear: we know research is making a difference because we can measure its impacts. Our expertise in measuring and monitoring what we do is recognized nationally and internationally in the research evaluation field. Our in-house impact assessment unit uses mixed methods and multiple data sources to better understand and report on the impacts of AIHS’s investments in health research and innovation. The results are data driven and evidence-based, and show a range of impacts that are important to Albertans.

The most recently acquired tool used by our impact assessment unit is Researchfish, a standardized and internationally used online system that researchers report into so that funders can capture and track the impacts of investments. We began using this tool in early 2015, the first organization in the Western Hemisphere to do so. We started with three of AIHS’s funding programs: Collaborative Research and Innovation Opportunities (CRIO), Partnership for Research and Innovation in the Health System (PRIHS), and Translational Health Chairs. These three programs have funding terms of between three and seven years. Data was gathered on activities occurring in the first year to 18 months of each program—the first implementation phase of the Researchfish tool. The resulting data and the impacts the researchers described are contained in the first AIHS Annual Impact Report. Selected results for the \$20.8 million invested are highlighted in the figure on the right.





The first Annual Impact Report highlights progress across several categories of impact. One finding is the large amount achieved in some categories even in the earliest stages of the funding cycle. Another is the high level of collaboration and engagement of our researchers at the early funding cycle stage, activity that is crucial to move down the pathway from health research to impacts that make a difference in the lives of Albertans. Several exemplars highlight these early stage impacts. The findings also reinforce that medium and longer-term (distal) impacts such as health, social and economic benefits require longer timelines, but cannot occur without the activities reported in the early stages.

In addition to showing impact in real time, we use evidence from impacts to inform future health research and innovation supports that will contribute to the improvements that the government is seeking for Albertans.

In times of scarce resources, using evidence to allocate dollars is necessary and using monitoring and evaluation as a learning tool can assist greatly in this responsibility. Our ability to fund quality research and innovation, catalyze health system improvement, facilitate partnerships to accelerate change, and measure the impact of what we are doing contributes to better health, social and economic gains for Albertans.

Key Findings from the AIHS Annual Impact Report: 2014-2015

- Even at the earliest stages of the funding cycle, research is achieving impact and progress is being made to achieving medium and longer-term impacts in health, social and economic prosperity.
- The impacts reported are in real time and proximal in nature.
- Health, social and economic benefits require longer timelines to realize, both during and after the funding cycle.
- AIHS-funded researchers are highly engaged and collaborative.
- Leveraged funding is being generated and, based on historical evidence, will increase in the later stages of the funding cycle.

INTRODUCTION

Overview

Alberta Innovates – Health Solutions (AIHS) supports research and innovation that contribute to the improved health and wellbeing of Albertans and the health system. AIHS-supported research also contributes to health-related social and economic benefits for all Albertans through these improvements and innovations. In addition to competitive health research funding that aligns with the province's Health Research and Innovation Strategy,¹ AIHS provides infrastructure supports to enable the provincial ecosystem such as the Strategic Patient Oriented Research (SPOR) and Secondary Use Data Platforms. These funding and support mechanisms generate knowledge to inform decision making and adoption of research findings into policy and practice.

As a publicly funded health research organization, AIHS uses monitoring and evaluation for the purposes of accountability as well as learning how to maximize the impact of its investments. The AIHS Annual Impact Report: 2014-15 is one of the mechanisms that highlight the progress to impacts being made on an annual basis. Impact information was self-reported by researchers who were receiving AIHS funding through one or more of the following funding opportunities: Collaborative Research and Innovation Opportunities (CRIO), Partnership for Research and Innovation in the Health System (PRIHS), and Translational Health Chairs (see **Data Collection Period**).

AIHS's approach to Performance Management and Evaluation is outlined in this Introduction, including insight into the AIHS *Health Research to Impact Framework* used to guide the assessment of impacts achieved through AIHS's investments in health research. It also provides background information on Researchfish, the recently implemented electronic impact data collection system used by AIHS.

The funding opportunities and associated data collection periods that provided data for this report are outlined in Methods. This section also provides a brief explanation of the data cleaning and quality assurance process that was used, as well as the analytic approach taken.

The Results comprehensively summarize the progress to impacts being achieved by AIHS-supported researchers in the 2014-15 fiscal year and, for a few researchers, up to six months prior to that (see **Data Collection Period**). The reported impact data have been classified according to the impact categories identified in the

Canadian Academy of Health Sciences (CAHS) report entitled *Making an Impact: A Preferred Framework and Indicators to Measure Returns on Investment in Health Research*² and used in the AIHS *Health Research to Impact Framework* (see **AIHS: Health Research to Impact Framework**). Within each of the impact categories, the results have been subgrouped by the relevant outcome categories outlined in Researchfish (see **Annual Impact Reports: Researchfish**) (see **Glossary in APPENDIX A** for the definitions of outcome and impact).

Exemplars are included throughout the report to highlight progress to impact. The header of each exemplar identifies the CAHS impact categories that align to the researcher's achievements as highlighted in the exemplar.

A summary is provided to highlight what are considered key findings of the data from AIHS's perspective and to bring forward some considerations about the findings, including limitations.

A glossary is provided in APPENDIX A to guide the interpretation of various terms used in this report. For example, the words "collaborator" and "partner" are used synonymously in this report as they are used in an undefined and interchangeable manner within the impact data collection system used by AIHS. Also, while the terms "impact" and "outcome" are often used interchangeably, the term "impact category" was used to reference the categories outlined in the CAHS framework,² while "outcome category" reflects the high-level categories used in Researchfish. More specific information about the data collection period has been provided in APPENDIX B. Information about the calculation of the leveraged funding ratios is provided in APPENDIX C, while APPENDIX D will help the reader understand the results associated with the "Medical Products, Interventions and Clinical Trials" outcome category in Researchfish.

It is important to note that throughout this report the term "researcher" was used to refer to individual researchers and/or groups of researchers who were the successful applicants of the AIHS awards or grants and who provided impact data for this report. The term "research group" is used in reference to the wide variety of staff and trainees who work on research being conducted by the "researcher."

Performance Management and Evaluation at AIHS

One goal at AIHS is to better understand the impacts of its investments, which can range from academic impacts to a wider impact. This is accomplished through the application of a comprehensive approach to impact assessment for the purposes of accountability and transparency to the public, learning and increasing the general level of awareness of the benefits of research and innovation. AIHS is continually striving to improve its understanding of how the research investments it makes affect Albertans' health, the health system and ultimately contribute to social and economic benefits in the province. Beyond simply demonstrating the impact of the research we support, AIHS strives to maximize benefits from its research investments by using the impact evidence to inform strategic decisions about its funding activities and by working with our partners, stakeholders and the health research community to achieve better health and prosperity for Albertans.

AIHS has a long history in health research impact assessment and has been directly collecting impact data from its researchers for more than six years. The Performance Management and Evaluation (PME) team at AIHS provides the expertise to assess the value and impact of our investments so that we can continue to improve as an organization and to support health system innovation in Alberta and beyond. Members of the PME team are active participants in a growing community of practice that plans how to gather impact information, how to measure and understand it and how to communicate the results. It ultimately helps us improve what we do and how we do it. The competence and ingenuity that AIHS has in these areas is a strength that AIHS offers to the provincial and global research and innovation environment.

AIHS aims to communicate the evidence about the health research and innovation outputs, outcomes and impacts being achieved through its research investments. As a publicly funded research organization, it is essential that AIHS demonstrate the value for money that the government of Alberta and its citizens are receiving through their investments in AIHS. Implicitly or explicitly, governments the world over are increasingly asking questions about whether they are getting value for money from their support of research and innovation.³ It is also anticipated

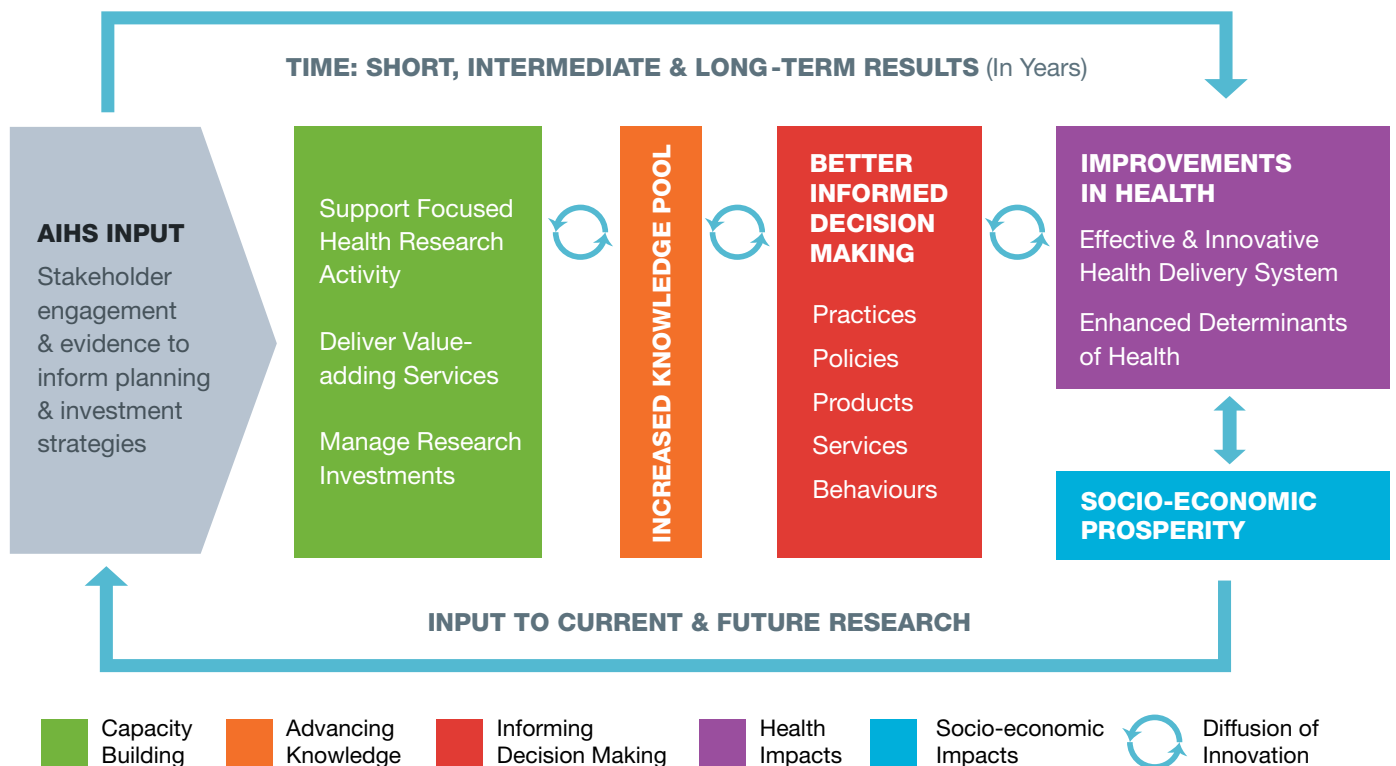
that the quality of impact reporting will improve as the research community better understands the need to more fully and accurately report on the achievements they make through publicly funded research activities. This can be assisted, in part, through the sharing of AIHS impact results with the research community and also through more active engagement between AIHS and the research community in relation to impact assessment and reporting.

HEALTH RESEARCH TO IMPACT FRAMEWORK

AIHS developed and implemented a *Health Research to Impact Framework* (Figure 1) to track research activities across the continuum from investment to results. This framework, which is systematically used to guide the evaluation of AIHS's research investments, enables AIHS to assess whether its organizational and funding activities are relevant (strategically aligned; meet the needs they are trying to address), effective (meet our mission; achieve their objectives and outcomes), and efficient (timeliness; maximize cost to benefit). Based on the CAHS (2009) framework and developed to reflect the integration of practice-based evidence and evidence-based practices, the *Health Research to Impact Framework* guides the systematic collection, analysis and reporting of results in order to inform decision making and facilitate action within our organization and our stakeholder community.^{2,4}

FIGURE 1
AIHS Health Research to Impact Framework

AIHS Mission & Vision



The CAHS framework provides stakeholders in the health research ecosystem (e.g., funding organizations, government, academic institutions, industry and other stakeholders) with a common language and theory about the benefits of health research and how to evaluate them. The work of Graham and colleagues (2012) found that while the CAHS framework provides essential groundwork and was determined to be applicable to AIHS and feasible for it to implement,⁴ modifications were required via the *Health Research to Impact Framework* to:

- Better align to AIHS's business needs (e.g., different program objectives);
- Ensure that the framework was driven by AIHS's mission and vision;
- Integrate performance management through the inclusion of several organizational indicators that were not proposed in the CAHS model; and
- Include "reach," a concept that extends beyond the traditional notion of participation to include interactions (e.g., the collaborations and partnerships one engages in) and the "who," or target audiences, one is wanting to effect change in.⁵

Implementation of the *Health Research to Impact Framework* has changed the way AIHS monitors and evaluates its research investments. The measurement and assessment of impact has been extended beyond academic value to include social value and organizational performance. Return on investment is no longer conceptualized simply in terms of publications and capacity building but also in terms of how research contributes to informing decision making and improved practice in health and health systems, and the generation of products and services that contribute to economic growth.

ANNUAL IMPACT REPORTS: RESEARCHFISH

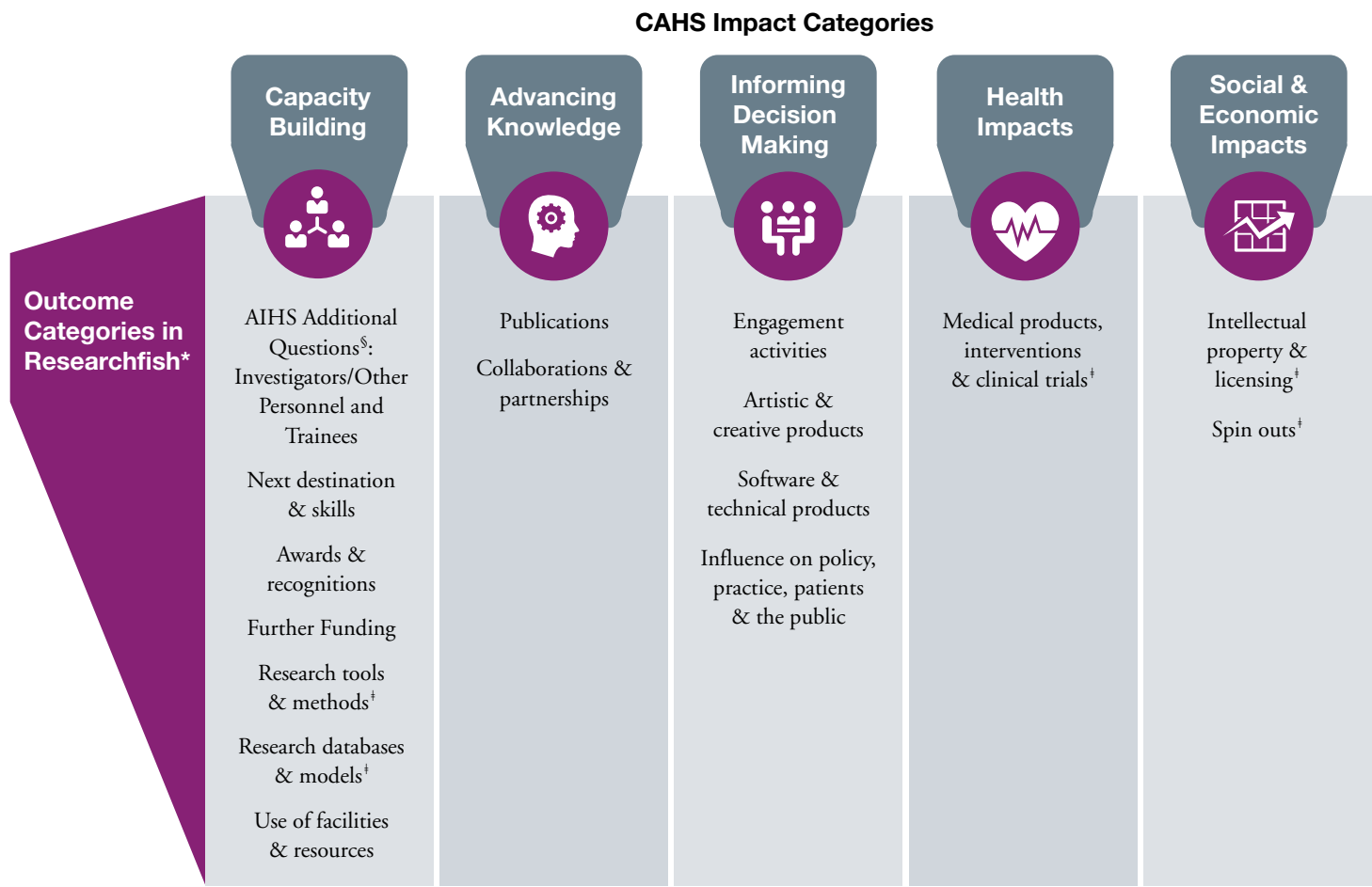
AIHS’s provincial health research and innovation community has been telling us for years that it needs a simpler, more flexible and more useful way to complete required reporting on its activity. In response to this and to meet an organizational business need, AIHS replaced its use of word processor-based annual reports in April 2015 with an electronic impact data collection system called Researchfish (www.researchfish.com).

Developed by the Medical Research Council in the United Kingdom and used by more than 62,000 researchers globally, Researchfish aligns closely with the *Health Research to Impact*

Framework implemented by AIHS. This enables AIHS to systematically and efficiently gather information about progress being made toward a wide range of impacts by its funded researchers. AIHS mapped the 16 outcome categories in Researchfish to the impact categories reflected in the CAHS framework and the *Health Research to Impact Framework* implemented by AIHS (Table 1).^{2,4} In relation to Table 1, it should be noted that some outcome categories could align with more than one of the CAHS impact categories. In such cases, AIHS mapped the outcome category to the anticipated impact area (i.e., where the outcome is most likely to have an impact).

TABLE 1

Mapping Researchfish Outcome Categories to the CAHS Impact Categories



* The general outcome category of “Other Outputs & Knowledge/Future Steps” was not mapped to an impact category. This category is used by researchers to provide feedback to funders about their research or how it has been applied by others and which cannot be captured in other outcome categories.

† The Researchfish outcome category may align with more than one CAHS impact category and was therefore mapped to the anticipated impact area.

§ Additional questions were included in the Annual Impact Report to collect data in relation to (i) investigators and other personnel employed in association with the AIHS-supported research activities and (ii) trainees participating in the AIHS-supported research. Information was also collected about the training and mentorship opportunities provided to trainees under the AIHS-supported research activities.

Researchfish is an easy-to-use, standard electronic tool for capturing and analyzing impacts across the spectrum of research and innovation activity in the province. This system enables researchers to invite members of a research group to view the outcome data entered for a specific award or grant and allows members of the research group to assign data from their own portfolios to the shared award. As researchers have individual portfolios within Researchfish that can contain more outcomes than those attributed to the AIHS funding, researchers can also use Researchfish to track their achievements and notable successes over time – information that may be invaluable when reporting to their institution, funders, the public and others during the funding period and even after the funding has ended.

The information collected through Annual Impact Reports via Researchfish will be invaluable to AIHS. The information will contribute to the evidence we submit to make the continued case for sustained investment in health research and innovation in Alberta and beyond. The impact data will also be used to assess the progress being made to AIHS's goal of informing internal funding processes. Importantly, the reported outcomes will be shared in an aggregate manner with the research community and other AIHS stakeholders. Being a standardized data collection tool, Researchfish provides AIHS with an unprecedented opportunity to share, compare and/or aggregate its impacts with other funders who use this system (i.e., apples to apples). The academic institutions of AIHS-funded researchers also have the opportunity to access the impact data in Researchfish that is associated with their academics.

METHODS

Data Collection Period

Data for the AIHS Annual Impact Report: 2014-15 was collected through the first phase of implementation of AIHS's new electronic impact data collection system (Researchfish). This initial implementation occurred in April 2015 and involved researchers supported through Collaboration Research and Innovation Opportunities (CRIO), Partnership for Research and Innovation in the Health System (PRIHS), and Translational Health Chairs (Table 2). As highlighted in APPENDIX B, not all reported impacts were limited to activities and outcomes that occurred in the 2014-15 fiscal year (i.e., April 1, 2014, to March 31, 2015) because some researchers had not previously submitted impact data to AIHS and had funding start dates prior to April 1, 2014.

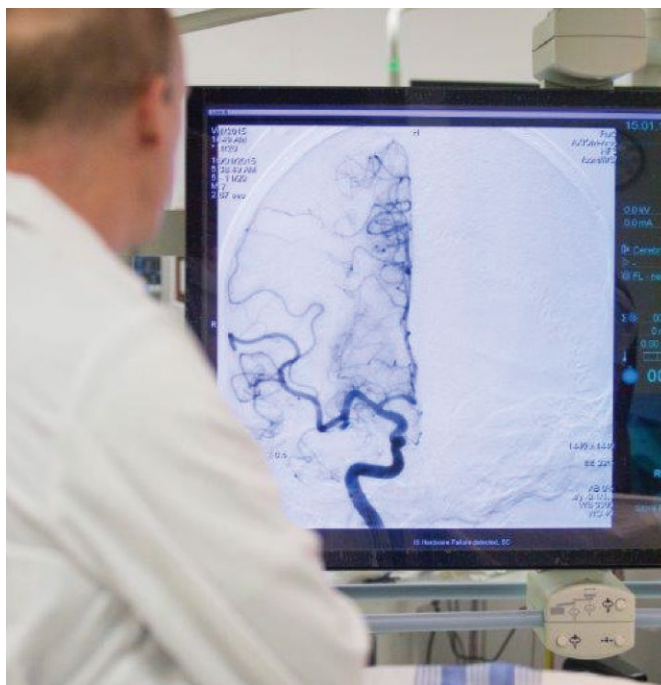


TABLE 2
Funding Opportunities Included in the Initial Implementation
Phase of Researchfish

Funding Opportunity	Description	Number of Grants/Awards	Total Award/Grant Value
Collaborative Research & Innovation Opportunities (CRIO)	Funding for collaborative research in priority areas for Alberta that engage knowledge- and/or end-users for the purposes of producing new knowledge and translating that knowledge to improve health and the health care system.		
	CRIO Team: Enables a large, interdisciplinary team or network of researchers with national or international stature to tackle health issues involving many stakeholder groups. The team must have an experienced leader. The research activities must engage knowledge- and/or end-users to encourage uptake of evidence and must be aligned to priority areas of health for Albertans. <i>Up to \$1,000,000 per year for up to five years</i>	11	\$52,759,090
	CRIO Program: Enables a group of interdisciplinary collaborators (minimum three) who may already work together to focus on a complex program of health research and innovation that addresses health research needs, gaps or opportunities. The research program must engage knowledge- and/or end-users to encourage uptake of evidence and must be aligned to priority areas of health for Albertans. <i>Up to \$500,000 per year for five years</i>	6	\$14,879,870
	CRIO Project: Allows a small group of interdisciplinary collaborators (minimum three) to come together with knowledge- and/or end-users to complete a defined health research project with defined deliverables. <i>Up to \$250,000 per year for up to three years</i>	20	\$14,581,414
	CRIO Project Cancer: Funds cancer research across the cancer continuum, from causes and prevention to treatment and care, enabling a small group of interdisciplinary collaborators (minimum three) to come together with knowledge- and/or end-users to complete a defined health research project with defined deliverables. <i>Up to \$250,000 per year for up to three years</i>	18	\$12,897,068
Partnership for Research & Innovation in the Health System (PRIHS)	Funding established through a partnership with Alberta Health Services (AHS) that aims to support networks of health researchers and clinical practitioners for the purpose of identifying sustainable solutions to improve overall quality of care and value for money in the health system. <i>Up to \$250,000 per year for up to three years</i>	10	\$7,459,200
Translational Health Chairs	A partnership with Alberta's Comprehensive Academic and Research Institutions to recruit translational health leadership in priority areas to improve health and the health system. <i>From \$250,000 to \$600,000 per year for seven years</i>	4	\$12,200,000

Data Management and Quality Assurance

Some necessary steps were taken to clean the data submitted by researchers. For “Collaborations and Partnerships,” Researchfish completed a standardized internal process to ensure valid locations were used for each collaborator and partner. This information will subsequently be added to the predictive inputs within Researchfish.

If a country or organization name was manually entered by the researcher, AIHS ensured that a consistent nomenclature was used (e.g., no space after the name; “Australia” instead of “Australia, Commonwealth of”; full name of an organization instead of an acronym).

AIHS conducted an internal review of the number of collaborative leads/co-leads and collaborative members reported on the Annual Impact Reports (in the section titled AIHS Additional Questions) by comparing the reported number with that previously reported on program administrative records. In all cases, the source of record was the count as per the most recent administrative record, and AIHS staff contacted researchers to discuss discrepancies and required actions, if any. There were 20 (29%) annual impact reports with minor discrepancies that resulted from transcription errors, changes in research group members that had not been reported to and/or approved by AIHS by the time of the annual impact report submission, counting errors and misunderstandings about the information being sought.

For reported publications, journal articles that were imported into Researchfish by researchers and accompanied by a PubMed identification number (PMID) were not further verified. If a publication was manually entered and/or if a PMID was not included, AIHS’s research librarian verified the reported entry and coded the entry (e.g., published journal article; abstract; in press). Reports of book chapters, monographs and “other” were also verified and/or coded by the research librarian. Conference proceedings/abstracts, policy briefing reports, and working papers were accepted as reported due to challenges in tracking and verifying these publications.

The data used for this report were self-reported by AIHS researchers, and an audit was not done to verify the accuracy of reported data apart from the procedures outlined above for counts of collaborative leads/co-leads and collaborative members as well as publications. The cleaning and quality assurance processes that were completed are correct as of October 15, 2015. However, the data may be subject to alteration later if additional information is received by AIHS in relation to the reported data.

Analysis

This report is focused on the returns on investment that AIHS is realizing across a portfolio of funding programs. Therefore, the results from the different funding opportunities were aggregated. In instances in which the same outcome was reported in association with more than one AIHS-funded research award/grant, the duplicate entry was removed from the data so that each outcome, to the extent reasonably possible, was only counted once. These duplications occurred when an individual researcher was participating in more than one AIHS research award/grant and reported the same outcome for each. While system-generated codes are used to identify instances of duplicate outcomes, it is possible that some duplicates were not identified if members of a research group provided similar (but not identical) information independently of one another.

The analysis of quantitative results was limited to descriptive statistics due to the relatively limited number of researchers enrolled through the first phase of implementation of the electronic impact data collection system. Further, all researchers did not have outcomes to report in all categories. When data were approximately normally distributed, the mean and standard deviation (SD) are reported. However, for data that had a markedly non-normal distribution as indicated by a SD that exceeded one-half of the mean, the median and range (as expressed with minimum and maximum values) are reported.⁶ Analyses of quantitative data were completed using Microsoft Excel software. Throughout the report, percentages were rounded up or down to the nearest whole number or, in tables, to the first decimal point. This rounding may result in not all percentages summing to 100 percent in a given section or table.

Leveraged funding, which is funding that was received after the start date of AIHS funding and before the end of the funding period, is a key indicator used by AIHS. However, Researchfish collects data on further funding that includes funding that predates the start date of the AIHS funding. This required AIHS to remove further funding that predated the start date of the AIHS funding from the data so that leveraged funding could be calculated. In the event that the month of the further funding start date was not reported, January was used as the default month. This methodological approach is consistent with that used by the Medical Research Council and other funders in the United Kingdom. As well, to avoid circularity, further funding that was provided by AIHS was removed from the numerator as per APPENDIX C.

As with further (leveraged) funding, outcomes reported in several other impact categories were also deemed to be “inappropriate” if the date of the outcome predated the start of the AIHS funding. These outcome categories included “Next Destination and Skills,” “Awards and Recognitions,” “Research Tools and Methods,” “Research Databases and Models,” “Software and Technical Products,” “Artistic and Creative Products,” “Medical Products, Interventions and Clinical Trials,” “Intellectual Property and Licensing” and “Spin Outs.”

Recognizing that research often stems from previous activities and is enabled by pre-existing relationships with collaborators/partners and other stakeholders, outcomes that predated the AIHS funding were retained as “appropriate” in the impact categories of “Collaborations and Partnerships,” “Engagement Activities” and “Use of Facilities and Resources.” Similarly, as the outcome category of “Influence on Policy” includes outcomes that can predate the AIHS funding (e.g., membership in a guidance committee or participation in national consultations or advisory committees), all reported outcomes were considered to be “appropriate.”

For some outcomes, researchers were asked to report the year associated with the reported outcome but were not required to specify the month. This means that a one-year difference could be almost two years in actuality (from January of one calendar year to December of the following calendar year).⁷ Therefore, for a reported outcome to be deemed “inappropriate” and hence removed from the analysis, the outcome would have to have been in the calendar year prior to the year in which the funding started or earlier.

AIHS supports the use of a mixed methods approach (i.e., using both quantitative and qualitative information) to better capture the progress to impact and ultimately the impact story. Researchfish collects qualitative data to validate and support several of the quantitative outcomes reported. The large amount of qualitative data collected necessitated a targeted approach to the analysis of this data, and several criteria were therefore used when identifying exemplars that highlight progress to impact. The criteria were:

- alignment to CAHS impact category
- diversity with respect to the grant/award type and location
- richness of data with respect to context
- richness of data with respect to the pathway to impact
- key topic area (e.g., patient perspective, vulnerable populations, specific disease states)

A basic interpretive analysis was conducted with the data collected in the outcome category “Collaborations and Partnerships.”⁸ Data were coded using QSR International’s NVivo 9 software as well as Microsoft Excel software and then inductively analyzed to identify common themes with respect to contributions to collaborations and impacts of collaboration. The analysis was also informed by the CAHS framework.

REPORTED PROGRESS TO IMPACTS

A total of 69 AIHS researchers were required to submit data for the AIHS Annual Impact Report: 2014-15 and 100% reporting compliance was achieved. The total award value of these 69 awards/grants based on the associated Notifications of Award was \$114.8 million. During the data collection periods used for this report (APPENDIX B), a total of \$20.8 million had been invested (expended) on these 69 researchers, representing 18% of the total award value.

Capacity Building

Capacity building within a research context is a process of individual or group development that leads to higher skill levels and an enhanced ability to perform useful research.⁹ This includes enabling the development of sustainable skills in personnel and trainees, adding or enhancing research infrastructure, and attracting additional financial resources in the support of research.

Three additional questions were included by AIHS on the Annual Impact Report to supplement the common data collected through the Researchfish outcome categories (Table 1). These questions focused on the type and number of investigators and other personnel (excluding trainees) who participated in the AIHS-supported research activities as well as the type and number of trainees who participated in the research. Information was also collected about the training and mentorship opportunities provided to trainees within the AIHS-supported research activities.

INVESTIGATORS AND OTHER PERSONNEL (EXCLUDING TRAINEES)

Of the 63 (91%) researchers who provided a response, it was reported that a total of 1,195 investigators and other personnel (excluding trainees) were involved in the CRIO, PRIHS and Translational Health Chair research activities. The median number of investigators and other personnel associated with the AIHS-funded research activities was 14 (min=2, max=83). More than half of these individuals were collaborative members as outlined in Table 3.

TABLE 3
Investigators and Other Personnel (Excluding Trainees)

Position	Personnel n (%)	Personnel per Award/Grant Median (min, max)
Collaborative Leads/Co-Leads	165 (13.8)	3 (0, 9)
Collaborative Members	622 (52.1)	6 (0, 80)
Project Management/Administrative Staff	76 (6.3)	1 (0, 8)
Research Staff	262 (21.9)	3 (0, 50)
Knowledge Translation/Exchange Staff	19 (1.6)	0 (0, 3)
Other Staff	51 (4.3)	0 (0, 16)
Total	1,195 (100)	14 (2, 83)

TRAINEES

There were 428 trainees involved with the AIHS-supported research among the 64 (93%) researchers who responded to the question. There were no trainees reported on two awards/grants, while a maximum of 26 were associated with another (median=5). The largest number of trainees were undergraduate/summer students and the proportions of trainees with a master’s degree, PhD or completing a post-doctoral fellowship were similar (Table 4).



TABLE 4
Trainees

Level of Training	Trainees n (%)	Trainees per Award/Grant Median (min, max)
Undergraduate/Summer Student	115 (26.9)	1 (0, 12)
Master's Student	89 (20.8)	1 (0, 10)
PhD Student	93 (21.6)	1 (0, 6)
Post-doctoral Fellow	96 (22.3)	1 (0, 10)
Health Professional Degree Student	36 (8.4)	0 (0, 5)
Total	428 (100)	5 (0, 26)

NEXT DESTINATION AND SKILLS

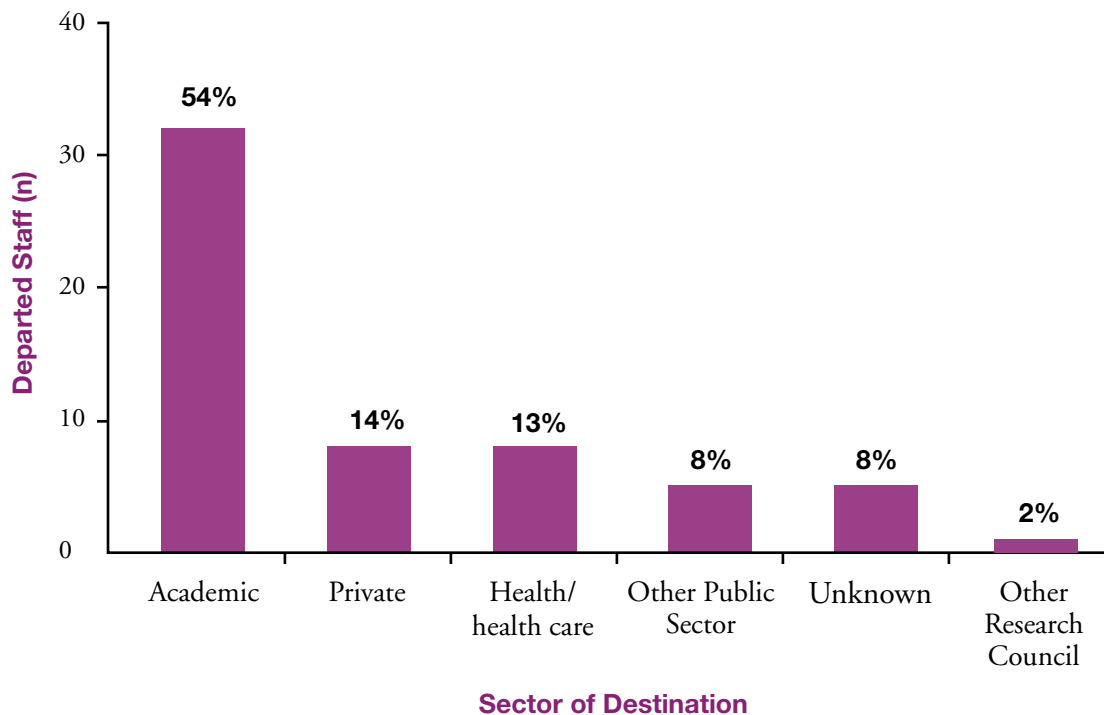
As in all areas of employment, attrition of researchers, trainees and other staff from research groups is to be expected. During the reporting period, 63 individuals whose salaries were wholly or partly funded by the CRIO, PRIHS or Translational Health Chair awards/grants departed from 27 (39%) of the research groups. The median number of individuals who departed these groups was two (min=1, max=8). These individuals also accounted for a total of 47 full-time equivalents (FTE) among the research groups. Nearly 65% of individuals who departed from the research groups were trainees, and stability of research project leadership was evident, with only 3% of attrition involving research project leaders.

After leaving the research groups, 69% of individuals remained in research-related roles. In particular, 29% of individuals were trainees or were otherwise engaged in study and an additional 33% of individuals had roles as researchers (no PhD), research project leaders, full-time lecturers or other research occupations. Several individuals (13%) had roles as health care or medical staff after leaving the research groups.

Just over half of individuals remained in the academic sector after leaving the research group (Figure 2) and 84% of all departed research group members remained in Canada.



FIGURE 2
Sector of Destination



Through their work in the research group, it was reported that 11 (32%) individuals gained undergraduate experience on research projects while 8 (24%) and 3 (9%) gained a master's degree or PhD, respectively. Nearly 72% of individuals gained their qualifications within 18 months of the funding start date and 92% within two years.

AWARDS AND RECOGNITIONS

This category collects information on significant awards, honours, appointments and other forms of recognition that were received during the AIHS-supported research. Outcomes such as personal pay awards or promotions, institution-specific awards and invitations to conferences that were not made to individually named persons were to be excluded. Thirty-two (46%) of the CRIO, PRIHS and Translational Health Chair researchers reported that a total of 103 awards and recognitions had been received by them personally or by members of their research groups during the AIHS-supported research activities. Among these researchers, the median number of awards or recognitions was two (min=1, max=18).



The largest number (n=57, 55%) of the awards and recognitions consisted of a research group member being personally asked to be a keynote speaker at a conference (Figure 3). Furthermore, half of the reported awards and recognition were at the international level (n=52, 50%) (Figure 4).

FIGURE 3
Types of Awards and Recognition Received

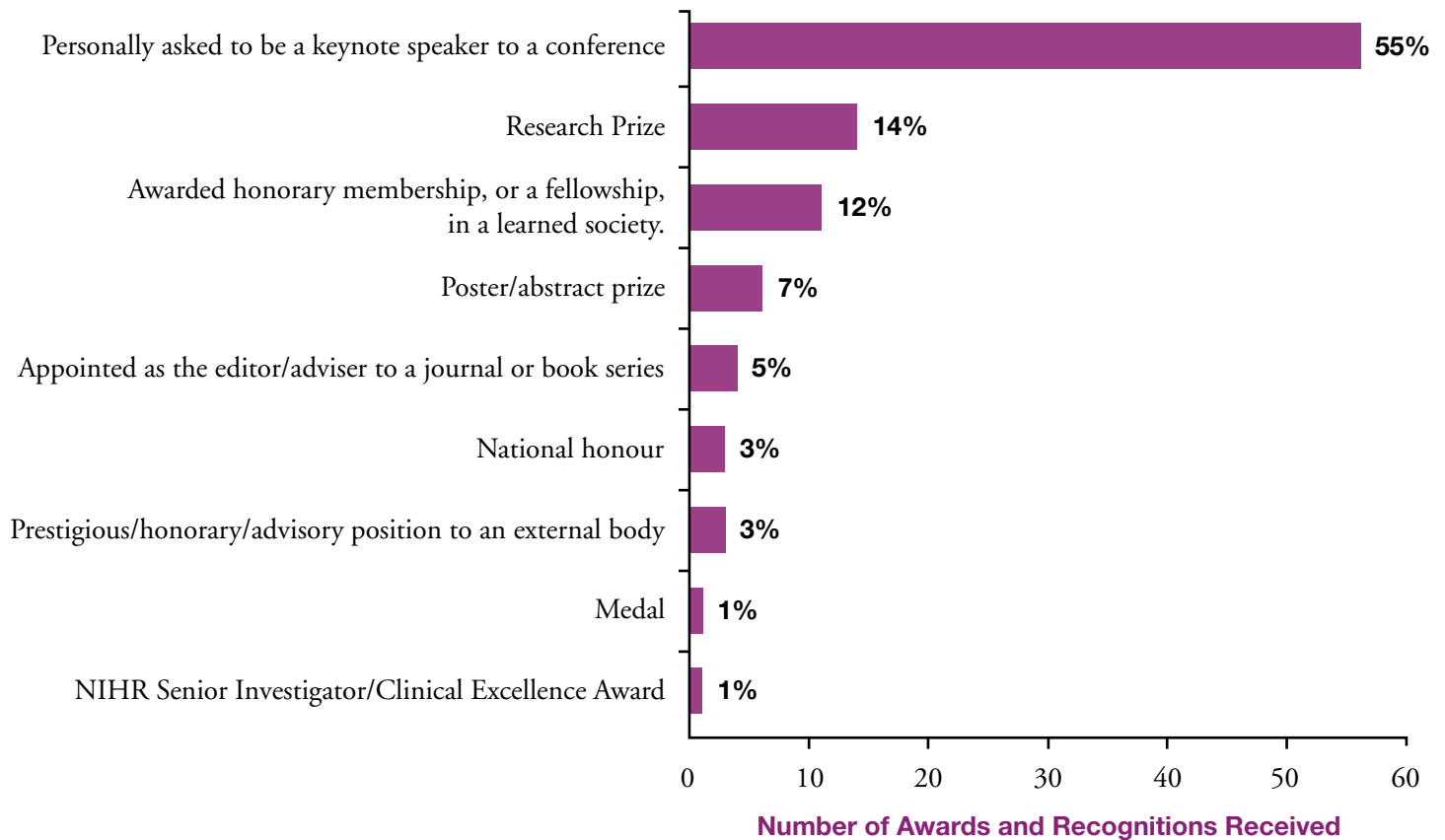
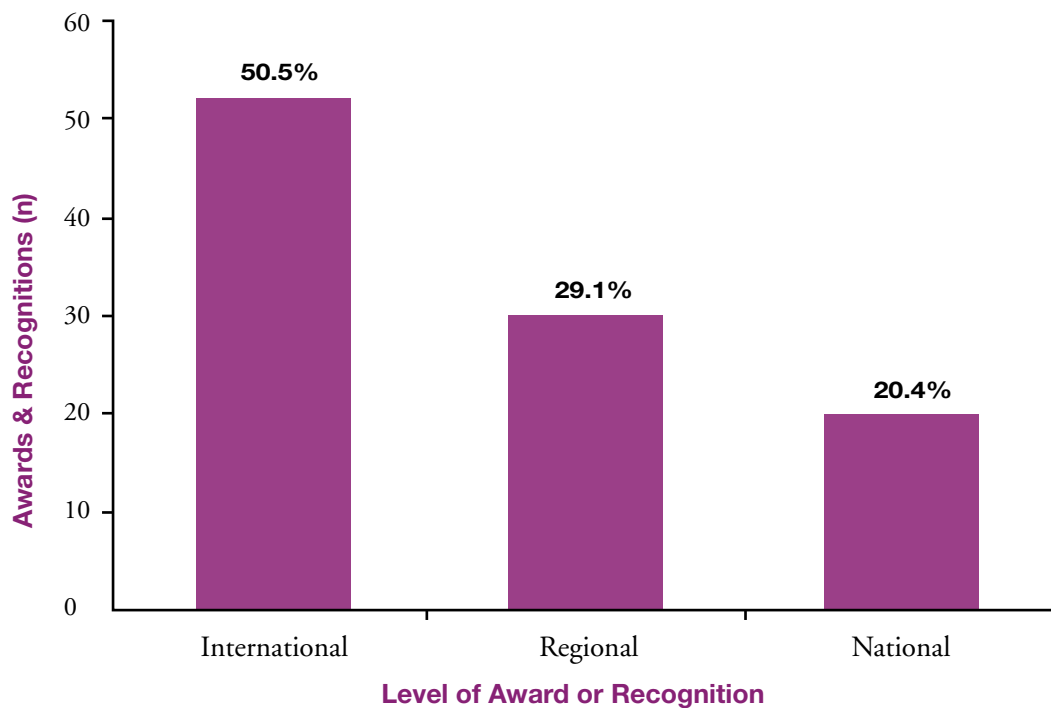


FIGURE 4
Geographical Level of Awards and Recognitions



FURTHER (LEVERAGED) FUNDING

In the reporting period, 41 (59%) researchers reported securing further funding subsequent to the start date of their respective AIHS awards. These leveraged funds were pledged to or received by these researchers through 175 additional funds whose median value was \$25,000 (min=\$500, max=\$5 million) and which had a combined value of \$37.2 million. There was also substantial diversity in the number of further funds received by each of the AIHS researchers who reported further funding (median=3, min=1, max=19).

The funding organizations that provided \$1 million or more in further (leveraged) funding are summarized in Table 5. Together, these eight organizations provided 74% of the further (leveraged) funds received by the AIHS researchers. A relatively large number of funds were also provided by the University of Calgary (n=28, 16.0%), University of Alberta (n=13, 7.4%) and Natural Sciences and Engineering Research Council of Canada (NSERC) (n=7, 4.0%), the average value of these funds being \$27,719, \$90,500 and \$27,123, respectively.



TABLE 5
Leading Contributors of Further (Leveraged) Funding
to AIHS-funded Researchers

Funding Organization	Further Funding	% of Total Further Funding	No. of Funds (% of all Funds)	Average \$ per Fund
Canadian Institutes of Health Research (CIHR)	\$10,801,746	29.0%	23 (13.1)	\$469,641
Alberta Cancer Foundation	\$5,715,425	15.4%	10 (5.7)	\$571,543
University Hospital Foundation	\$3,191,664	8.6%	2 (1.1)	\$1,595,832
Western Economic Development	\$2,983,737	8.0%	1 (0.6)	\$2,983,737
Prostate Cancer Canada	\$1,500,000	4.0%	1 (0.6)	\$1,500,000
Genome Canada	\$1,472,958	4.0%	1 (0.6)	\$1,472,958
Alberta Children's Hospital Research Institute	\$1,000,000	2.7%	1 (0.6)	\$1,000,000
Calgary Firefighters Burn Treatment Society	\$1,000,000	2.7%	1 (0.6)	\$1,000,000
Total	\$27,665,530	74.3%	40 (22.9)	

Research grants (including intramural programs) and studentships were the two most common types of further funding and together accounted for 79% of the number of further funds reported (Figure 5 and Table 6). As illustrated in Figure 5, however, the greatest proportions of leveraged dollars were associated with research grants and funding for capital/infrastructure (including equipment). This finding relates to the substantial heterogeneity in average value per fund (Table 6). For example, the median value of capital/infrastructure funds was 2 to 245 times that of other types of further funding.

FIGURE 5
Further (Leveraged) Funding

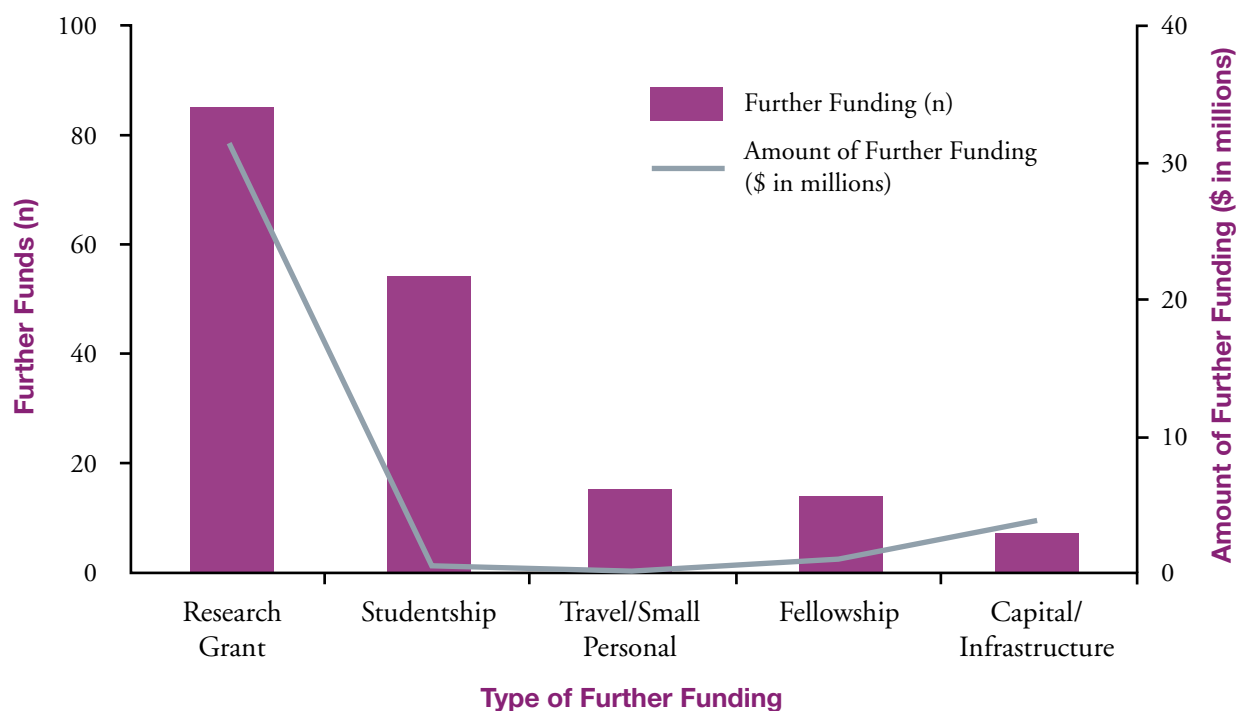


TABLE 6
Summary of Further (Leveraged) Funding

Type of Further Funding	Funds n (%)	Value (in 100,000s)	Median Value (Min; Max)
Capital/Infrastructure	7 (4.0)	\$39.0	\$200,000 (\$3,800; \$2,983,737)
Research Grant	85 (48.6)	\$313.8	\$100,000 (\$2,500; \$5,000,000)
Fellowship	14 (8.0)	\$12.2	\$65,571 (\$20,000; \$336,116)
Studentship	54 (30.9)	\$6.9	\$6,000 (\$1,000; \$120,000)
Travel/Small Personal	15 (8.6)	\$0.2	\$815 (\$500; \$6,000)
Total	175 (100)	\$372.2	\$2,500 (\$500; \$5,000,000)

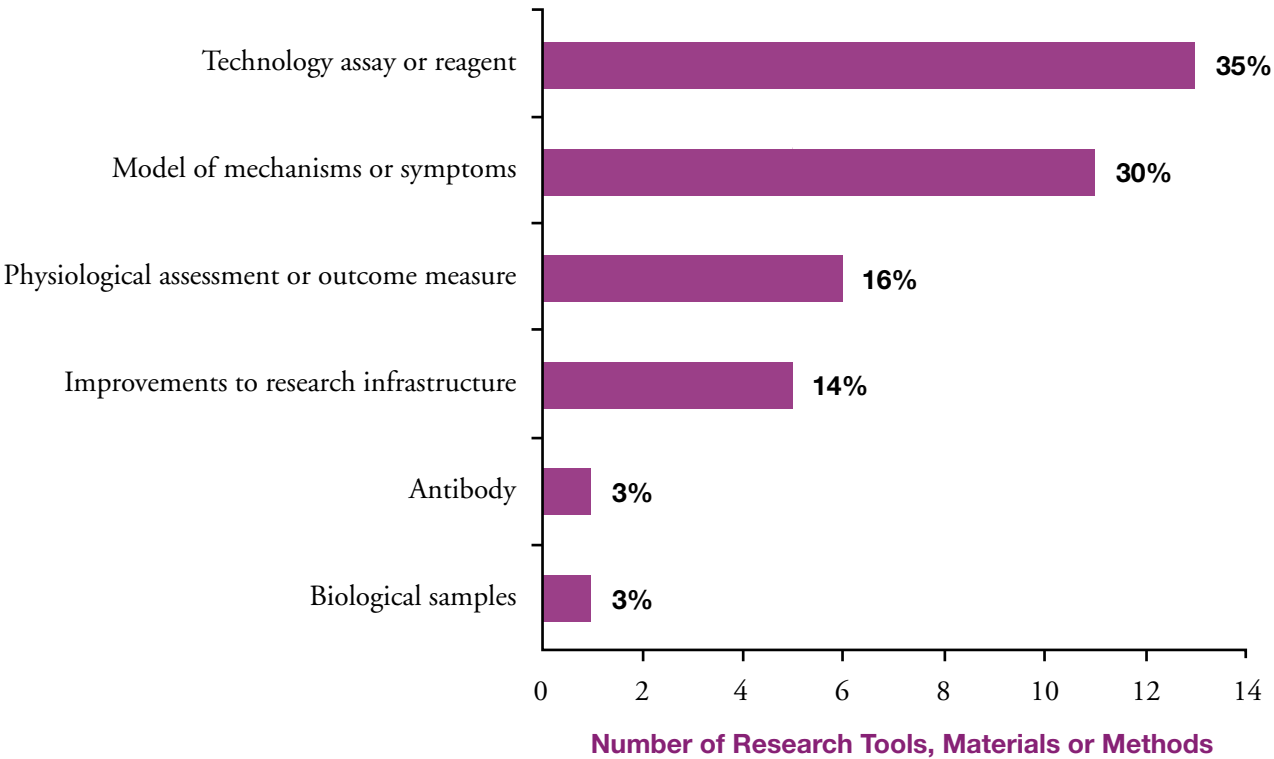
RESEARCH MATERIALS, TOOLS AND METHODS

The development of research materials, tools and methods can make a significant difference to the researchers’ studies or that of others by making new lines of inquiry possible. Twenty-two (32%) researchers reported developing a total of 37 new research materials, tools and methods as a direct result of their funded research activities (mean=1.7; SD=0.7). Twelve (32%) of these research material, tool or method developments had been shared with at least one other research group, and 75% of the time this had occurred within the same calendar year of the AIHS award or the following calendar year.

Technology assays and reagents accounted for 13 (35%) of the 37 reported materials, tools or methods developed by the researchers (Figure 6). Among the 11 (30%) researchers who developed a model of mechanisms or symptoms, human models (n=5, 14%) were the most common followed in descending order by mammalian in vivo, in vitro and non-mammalian in vitro (8%, 5% and 3%, respectively).



FIGURE 6
Number of Research Materials, Tools and Methods



Novel materials, tools and methods make a significant difference to research and its impact, particularly when they are made accessible to others. Two exemplars of advances in research methods with the potential to impact health interventions and patient outcomes in addition to research are provided by Dr. Khadaroo's research group and that of Drs. Shapiro, Light and Humar.

CAPACITY BUILDING

EXEMPLAR 1

Searching for a new gold standard

In the very elderly, a condition known as sarcopenia (i.e., reduced muscle mass) is predictive of complication rates, discharge disposition and in-hospital mortality. CT scans are widely recognized as the best available method to diagnosis sarcopenia, and hence the current “gold standard” diagnostic method for this condition. However, this method requires patients to be taken to the radiology department, exposes patients to high radiation, and is expensive.



Dr. Omar Alkathiri, a master's student co-supervised by Dr. Rachel Khadaroo, is studying the reliability and validity of thigh ultrasound as an inexpensive and non-invasive alternative for diagnosing sarcopenia in hospitalized patients. Dr. Alkathiri is comparing the muscle thickness measured by thigh ultrasound and CT scans while taking into consideration many clinical factors like age, co-morbidities and complications. Early findings suggest that thigh ultrasound has potential to be applied as part of the surgical assessment to help identify patients at risk. If successful, this could be the beginning of a new “gold standard” that could increase the health outcomes of patients while reducing diagnostic and treatment costs in the health system.

Supported by funding through PRIHS, the Elder-friendly Approaches to the Surgical Environment (EASE) initiative is led by Drs. Rachel Khadaroo, Fiona Clement, Jayna Holroyd-Leduc, Raj Padwal and Adrian Wagg.

EXEMPLAR 2

Game-changing treatment

Drs. James Shapiro, Peter Light and Atul Humar lead a CRIO team to develop an innovative method to transplant islet and stem cells in patients with difficult-to-control Type 1 diabetes (US Provisional Patent Application 62054769). Typically, insulin-creating islet cells from a donated pancreas are transplanted directly to the liver – a method known as the Edmonton Protocol, which Dr. Shapiro helped pioneer in 2000.

Instead of transplanting islet cells directly to the liver as per the Edmonton Protocol, the CRIO team's recent method builds off attempts to transplant cells under the skin. Recognizing that a lack of blood supply at the transplant site failed to sustain the cells, the team developed a method to trigger an immune response and bring blood vessels to the site by inserting a small tube under a patient's skin. The tube is removed after a month and donor islet cells or bioengineered stem cells are transplanted into this space.

This new “deviceless” method is not only safer and less invasive for patients receiving treatment for Type 1 diabetes, but is also more effective than previous methods. Dr. Shapiro and Dr. Andrew Pepper, a post-doctoral fellow, reported that this method effectively treated diabetes in 91% of the test patients in a pre-clinical model. This is a marked improvement relative to the Edmonton Protocol, which is effective in 5% of patients with Type 1 diabetes. Details on this new method were published in *Nature Biotechnology*, the highest-ranked primary research journal in biotechnology in 2014. The team also had an article published on this method in the *Diabetes, Metabolic Syndrome and Obesity Journal* in 2014. This article, “Islet cell transplantation for the treatment of Type 1 diabetes: recent advance and future challenges,” has already been cited in three clinical reviews and therefore has great potential to influence the treatment of diabetes across North America.

“

Clinical islet transplantation has transformed many lives, being critical for those patients hardest hit by the disease and for whom insulin injections are insufficient.

Dr. James Shapiro

July 29, 2015, Viacyte article

<http://viacyte.com/press-releases/viacyte-announces-second-clinical-trial-site-at-university-of-alberta/>

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Successful cell transplants mean that patients can be more insulin independent. Further, using bioengineered stem cells instead of donor islet cells will eliminate the need for donor pancreases. The impact of this method may well extend beyond diabetes research to potentially all regenerative treatments.

RESEARCH DATABASES AND MODELS

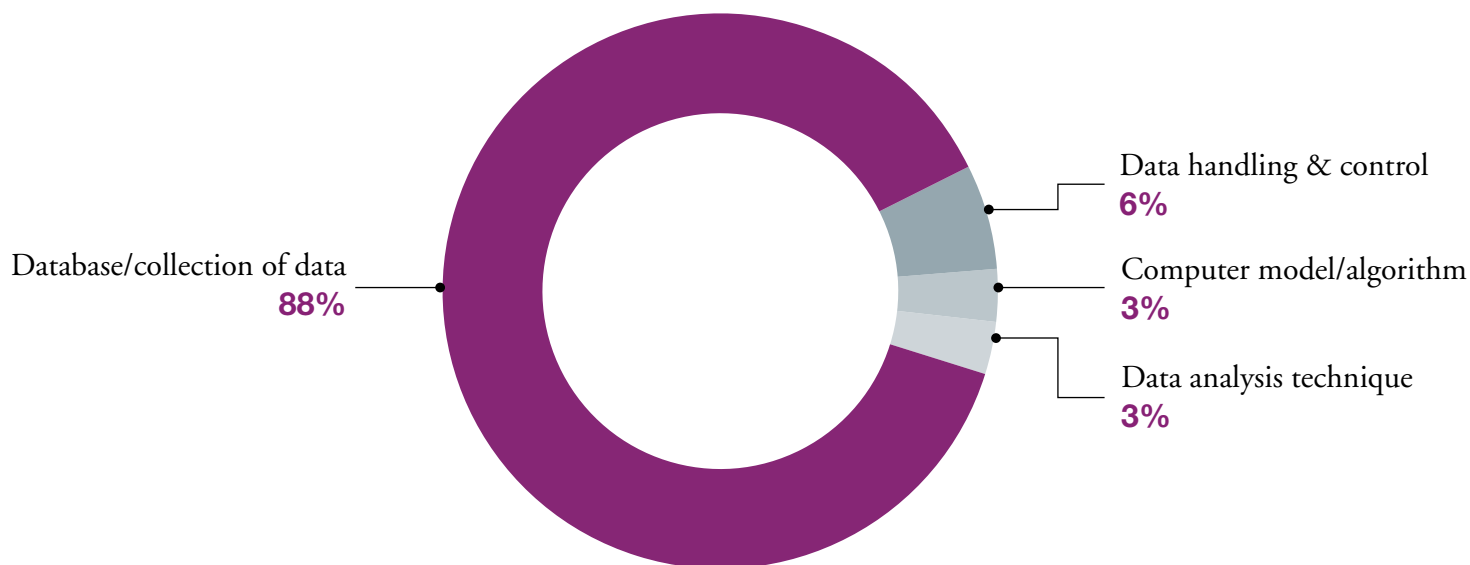
This outcome category captures information about new databases, data sets, collections and models produced by the researchers as part of AIHS-funded activities and that make a significant difference to their research and/or the research or work of others. This category is also used by researchers to report:

- Novel data analysis methods that the research has significantly influenced;
- Data handling and control systems that have applications outside of the original research area or technology (e.g., data matching, monitoring, etc.); and
- Novel advances in methods that could realistically affect the 3Rs (Replacement, Refinement & Reduction) that form the framework for humane animal research.¹⁰

A total of 33 outcomes were reported in the research databases and models category by 26 (38%) of the 69 researchers (mean=1.3; SD=0.4). Twenty-nine (88%) of these outcomes involved a database/collection of data (Figure 7) and this may require significant investment in the development of large-scale, longitudinal databases. The potential impact of such databases is amplified when the data are made available to other researchers, as was the case for 11 (33%) of the databases reported. The provision of research databases and models to other research groups predominantly occurred within one calendar year of the start year of the award (n=8; 73%). Two examples of research groups working to build databases to advance their fields are provided by research groups led by Drs. Lewis and Moore and Dr. Wishart.



FIGURE 7
Types of Research Databases and Models



EXEMPLAR 3

Building the tools to fight prostate cancer

Drs. John Lewis and Ronald Moore lead a CRIO project and are focused on developing new biomarkers and tools to fight prostate cancer. Key resources in this effort are the Alberta Prostate Cancer Registry and Biorepository. Together, the registry and biorepository will provide comprehensive data on how the outcomes of Alberta prostate cancer patients compare with international standards and outcomes in other locales.

The Alberta Prostate Cancer Registry's database will collect information from participants annually over 10-15 years. This information includes age and demographic details, family history of cancer, medication use, quality of life and cancer-associated health information.

383 participants took part in the study by March 31, 2015, with a goal to have over 8,000 enrolled in the Alberta Prostate Cancer Registry and Biorepository by 2020.

In 2014, the registry became available to other researchers, allowing them to track patterns of care and clinical outcomes, including incidence of cancer conversion, cancer therapy outcomes, changes in symptoms and quality of life, disease-related events and influences of co-morbidities on long-term health.

"This database will provide the necessary information for many translational research sub-studies," Dr. Lewis says. "It will be designed to evaluate biomarkers using genomic, proteomic, metabolomic and other emerging biomolecular techniques."

The research group has also developed and maintains a biorepository of biospecimens collected from patients throughout their journey from pre-diagnosis through treatment. The biospecimens, which include blood, urine, semen and tissue samples, are used to validate promising biomarkers for prostate cancer diagnosis as well as biomarkers of other aggressive diseases that could help in treatment decisions.

By linking the data in the Alberta Prostate Cancer Registry to the Biorepository and making these data available to other researchers, there is a tremendous opportunity to further advance our knowledge of prostate cancer through the application of advanced research techniques to a large study cohort.

“

Thinking is changing in terms of treatment and today more than ever, the clinical and academic research communities need resources to measure outcomes associated with different treatment modalities through comprehensive registries and high-quality biospecimens to test new biomarkers that can help better diagnose prostate cancer and predict disease outcomes by establishing biorepositories.

APCaRI website, accessed Sept. 21, 2015

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EXEMPLAR 4

Opening access to databases to advance research

Metabolomics is a new research field that specializes in analyzing the small molecules produced, absorbed, or ingested by living organisms. This field provides a new and powerful approach to understanding the molecular complexity of life.

Alberta is home to Dr. David Wishart, a leader in this field who was internationally recognized in 2014 as an Honorary Fellow of the Metabolomics Society for his outstanding contributions to the growth, use and understanding of metabolomics in the life sciences. This award recognized his successful establishment of numerous internationally recognized, open-access metabolomics databases and informatics resources and highlighted the metabolomics research conducted at the University of Alberta. His efforts have enabled important advances in the understanding of human health, disease and nutritional metabolomics.



“

Metabolomics is a new field of scientific study, but its impact is already apparent on the health and economic sectors in our province.

AIHS news release, Jan. 22, 2015

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Dr. Wishart is continuing with his work through his leadership of a CRIO team that tests, validates and assembles prototype medical diagnostic kits to create more accurate and less invasive blood, cerebrospinal fluid, and urine tests. The team developed a Nuclear Magnetic Resonance (NMR) kit that consists of a software program named Bayesil and an internal standards database known as the Bayesil Spectral Library. This kit automates the quantitative spectral profiling of over 50 compounds in two complex biofluids: cerebrospinal fluid and serum. Bayesil's biofluid-specific libraries include essentially all NMR-detectable metabolites in cerebrospinal fluid and serum in healthy humans. These libraries are essential to the performance of Bayesil and by extension the NMR kit as they provide exact reference spectral profiles to which other spectra can be compared.

Bayesil is the first fully automatic, publicly accessible system that effectively provides quantitative NMR spectral profiling of biofluids and does so with an accuracy that meets or exceeds the performance of trained experts. The NMR kit will allow many users to effectively and relatively inexpensively perform NMR analysis for high-value metabolites in biofluids. The Bayesil software is receiving significant attention, with its first publication in PloS One (2015) having been viewed more than 1,070 times within the first three months.

Researchers also reported developments with respect to data handling and control systems that have the potential to inform others' work. For example, the approach used by Dr. Currie in her research that involves the collection and handling of biological samples from Aboriginal participants can inform the work of others.

EXEMPLAR 5

Culturally appropriate data handling

Dr. Cheryl Currie holds the AIHS Translational Health Chair in Aboriginal Health & Wellbeing and researches the upstream determinants of Aboriginal health, strength and resilience in Canada.

She investigates how abuse, poverty, unemployment and other harmful events affect the endocrine, cardiovascular and immune system functioning of children and adults as measured through saliva samples. However, Aboriginal Peoples and community members are often sensitive about the collection of biological samples such as saliva from Aboriginal participants.



Given these known sensitivities, Dr. Currie conducted extensive consultations with Aboriginal stakeholders and Aboriginal Elders to find a community-based solution before beginning her study. From these consultations, Elders suggested that researchers return the samples to the earth at the end of their study in a traditional ceremony. Dr. Currie developed consent forms for the study to provide participants the option of having their saliva samples included in this ceremony, which will involve several Aboriginal Elders and the research group.

The benefit of her consultations was two-fold. First, she gained the respect of the community. Second, she found individuals were more willing to participate in her research once they learned that the research group would handle their saliva samples in a manner that respected their traditions.

Dr. Currie's approach provides other researchers with a method they may consider and discuss with Aboriginal stakeholders and communities. In the past, similar discussions took place after a study ended, making it more difficult to fully explore and enable culturally appropriate options.

USE OF FACILITIES AND RESOURCES

To assist AIHS in better identifying the types of facilities and resources accessed by researchers during their awards, researchers provided details about the use of any national or international shared facilities (e.g., high-throughput sequencing hubs, proteomics services, bio banks, etc.), services or resources (e.g., tissue/DNA banks; patient cohorts, etc.).

Overall, 10 (14%) researchers reported using a total of 21 shared facilities, resources or services (mean=2.1, SD=0.7). In four (19%) instances, the facility, resource or service was first used at least the calendar year prior to the start year of the AIHS award. Of the other instances, the vast majority of researchers (n=19, 90%) had accessed the shared facilities, resources or services within the same calendar year of the award start or in the subsequent calendar year.

Advancing Knowledge

In essence, research generates knowledge to inform policy and decision makers, practitioners, patients, public and other researchers about what works. “Advancing knowledge” refers to the process and mechanisms used to move knowledge beyond the researchers so that it creates awareness, understanding and opportunity to guide the decisions and actions of those stakeholders.

PUBLICATIONS

A total of 518 publications were produced in relation to the AIHS-funded research and had researchers or members of their research groups as named authors. These researchers or research group members were associated with 56 (81%) of the CRIO, PRIHS and Translational Health Chair grants/awards. The median number of publications among these researchers was 4.5 (min=1, max=50). When limited to journal articles – which accounted for 416 (80%) of all reported publications as illustrated in Figure 8 – the median number of publications per researcher was 3.5 (min=1, max=38).

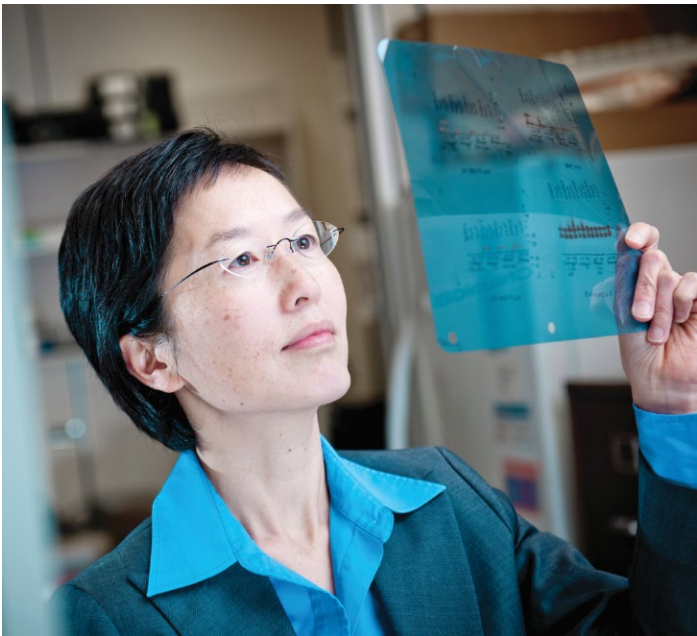
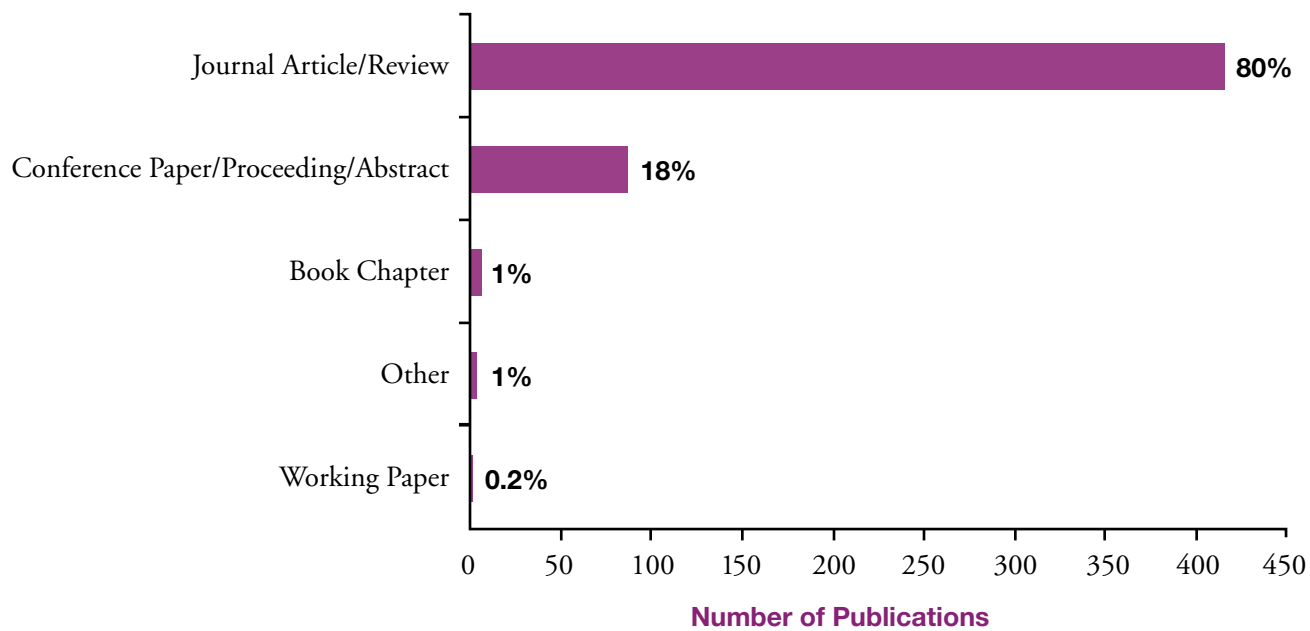


FIGURE 8
Publications



COLLABORATIONS AND PARTNERSHIPS

AIHS firmly believes in the value of collaboration and partnership. By working collaboratively, know-how is pooled, resources are leveraged and the impact of research and innovation success on health and wellbeing is maximized. Collaborative research also more often leads to commercial uses of research as measured by patents.¹¹ Factors such as enabling collaborative technologies, resources, sharing imperatives, scientific specialization and the melding of fields and policies that explicitly encourage collaboration have contributed to a rise in research collaboration.¹²⁻¹⁷ It is estimated that more than 90% of science, technology, engineering and mathematics research studies and publications are now collaborative.¹⁸

It was reported that a total of 198 collaborations and partnerships were used to support the health-related research activities of 45 (65%) awards, with a range of one to 45 collaborations and partnerships reported by these awards (median=3). Of these collaborations and partnerships, 82 (41%) were governed by formal agreements. The majority of researchers reported the early establishment

of collaborations and partnerships. Specifically, 58 (29%) collaborations and partnerships began before the start date of the AIHS award and 82 (41.4%) were established following the start date of the award but within the same calendar year as the start date of the award.

As some collaborations and partnerships relied on the participation of multiple organizations, a total of 217 individuals or organizations were reported as collaborators or partners within the 198 collaborations and partnerships. As per Figures 9 and 10, the vast majority (n=183; 84%) of these collaborators and partners were located in Canada and, more specifically, within Alberta (n=131, 72%) Outside of Canada, most collaborators and partners were located in the United States (n=13; 6%), Australia (n=4; 2%), Denmark (n=2, 1%) and the United Kingdom (n=2; 1%) or were global organizations in nature (n=4; 2%) (Figure 10). The largest number of collaborators and partners (n=78; 36%) were in the academic/university sector (see Figure 11).

FIGURE 9
Distribution of Collaborators and Partners in Canada

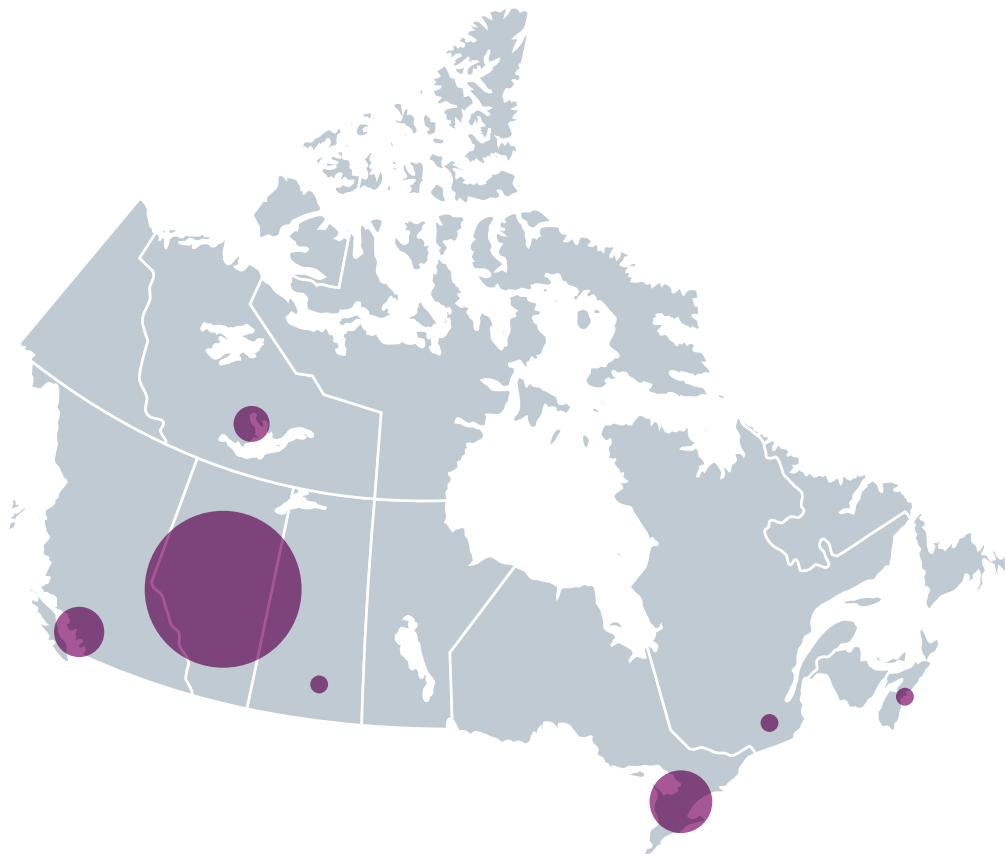


FIGURE 10
Global Distribution of Collaborators and Partners

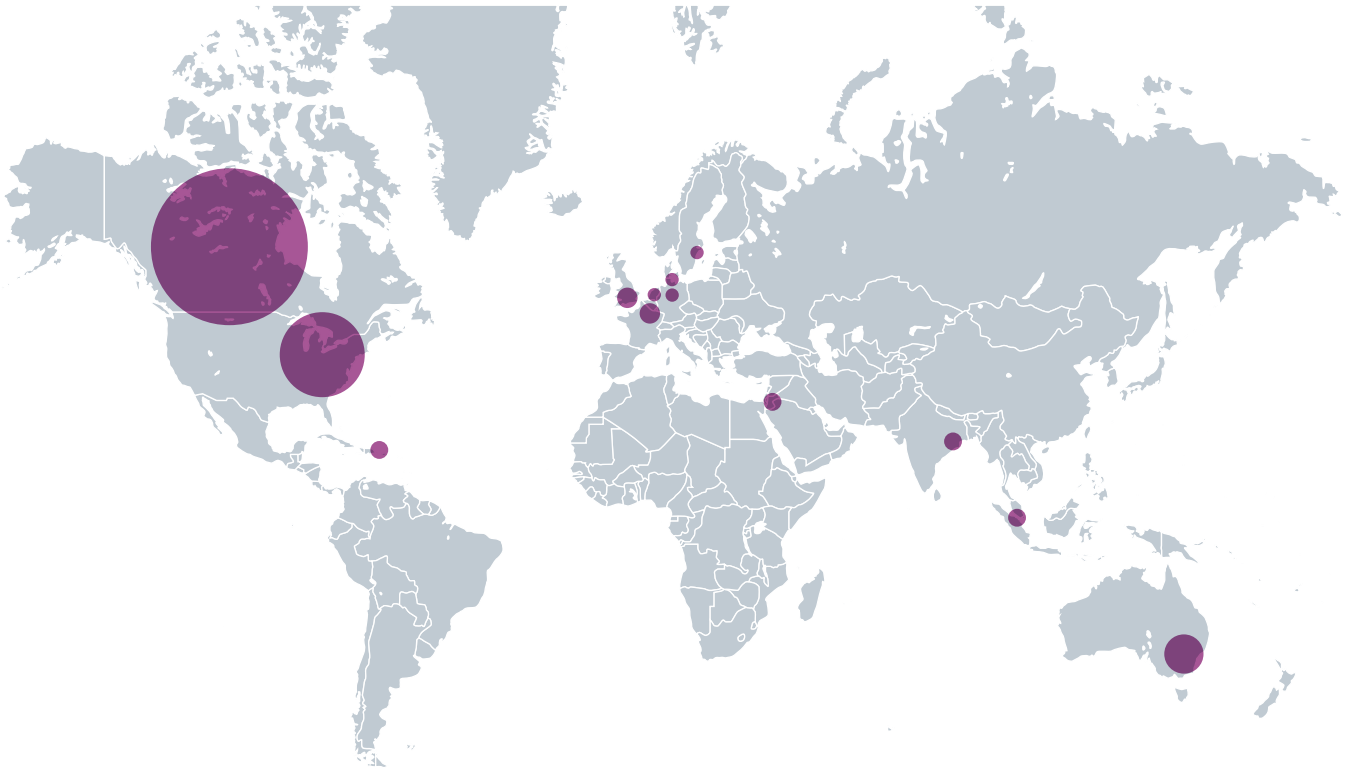
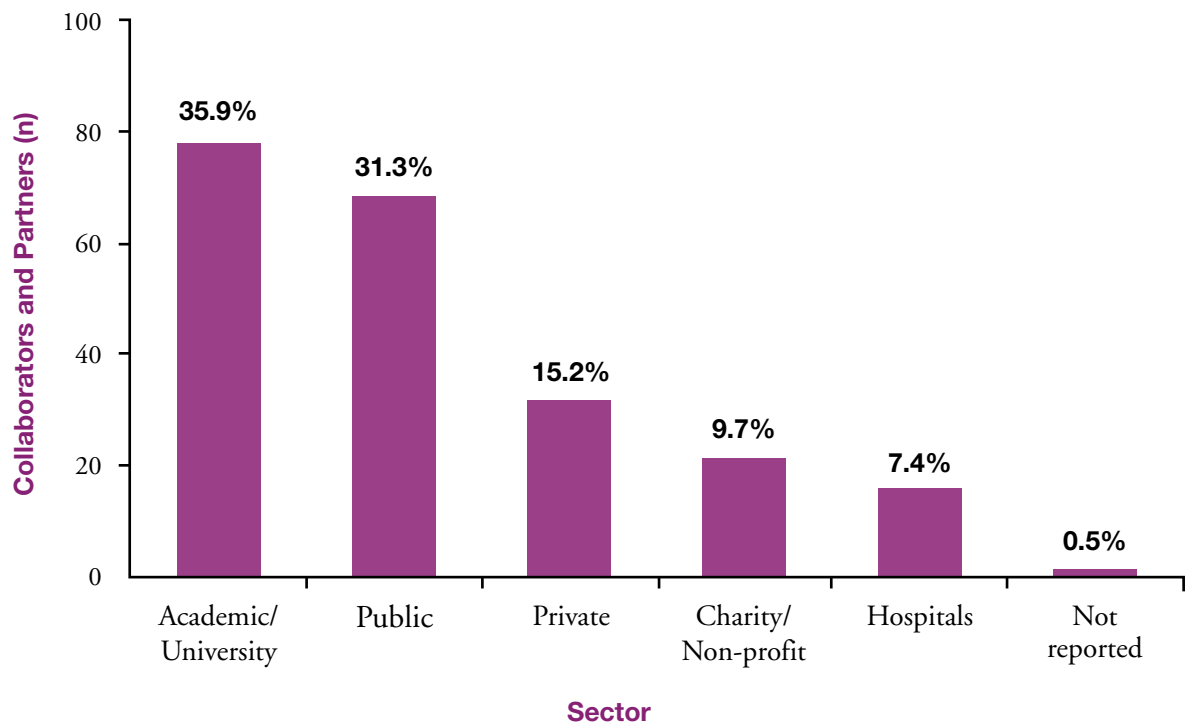


FIGURE 11
Sector of Collaborators and Partners



Collaboration as a Pathway to Impact

The collaborations reported by the researchers were qualitatively analyzed to identify what researchers and their partners contribute to collaborations and the impacts of these collaborations.

Contributions by both researchers and their collaborative partners fell within four areas:

Expertise

Researchers contributed significant scientific and clinical expertise to collaborations with stakeholders. These contributions included knowledge and experience pertaining to specific subject matter, study design, participant recruitment, data management, technology, literature reviews, methods and analysis, ethics approval processes, legal and privacy risk assessment, grant writing and manuscript preparation. Researchers also contributed expertise with respect to knowledge translation to move knowledge into action.

Partners also contributed expertise to the reported collaborations. Areas of expertise included research (e.g., qualitative methods, clinical trials), knowledge translation, and technical expertise (e.g., programming, imaging and clinical manufacture). Partners included other researchers as well as professionals from various fields including law, engineering, social work and clinical practice. Communities also contributed expertise by sharing their culture and traditions.

Resources

Researchers and their partners contributed the infrastructure and resources necessary to conduct research, including research models and tools, databases, facilities, funding, personnel and materials (e.g., precursors).

Management

Researchers typically managed research and knowledge translation initiatives and spearheaded collaborations. Often this role involved negotiating formal agreements with partners. In many cases, partners also led or managed collaborative initiatives.

Connections

Through collaboration, partners accessed each other's networks of connections. Connecting with others led to opportunities to collect data (e.g., access to patients to recruit them to research studies), access infrastructure, raise awareness of research among stakeholders and potentially develop new collaborations and partnerships. Some researchers reported accessing or providing access to formal networks such as the Strategic Clinical Networks (SCNs).

"Through our collaborations with Primary Care Networks (PCNs), we have provided linkages to researchers/investigators so that the community of practice is not only invited to engage in the research but is also part of the development of the research questions, thus ensuring the right questions are being asked and that the tools under study are adapted to what the community of practice really wants and needs."

Dr. Lee Green, THC

Impacts of Collaboration

Collaboration can assist greatly in progressing from research to impact and therefore can set the stage for ultimately achieving health and socio-economic impacts. Based on the data reported to AIHS, collaborations in the early stages of the funding cycle have led to early impacts in the areas of building capacity, advancing knowledge and informing decision making.

Collaborations Help Build Capacity

Through collaboration, researchers have increased the capacity for research in Alberta. They gained access to facilities and technology, data, study participants and personnel as well as co-applied for funding with partners. Some of these exchanges resulted in materials, software and tools that further contribute to research capacity. By and large, collaborators and partners did not provide financial contributions to the AIHS-funded researchers. Nonetheless, 25 (12%) collaborators and partners contributed nearly \$13.5 million to AIHS-funded researchers. This may underestimate the financial contributions of collaborators and partners, however, as information in relation to 19 (9%) collaborations and partnerships was contractually confidential. In-kind contributions were more common than financial ones, with reports of 76 (39%) of collaborators and partners providing the former.

“

This collaboration has allowed the CRIO team to build on the experience of National Research Council staff, as well as take advantage of the National Institute for Nanotechnology (NINT) facilities in the furthering of the CRIO team project goals. This collaboration has helped to complete CRIO team milestones, while the CRIO team staff have helped the NINT metabolomic sensors program in the furthering of its goals.

Dr. David Wishart, CRIO Team

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Collaboration also provided a mechanism for researchers to expand the reach of their research to multiple sites, allowing them to not only gather more data and build larger databases but also to explore different aspects of their research questions. For example, Dr. Bin Hu has collaborated with researchers nationally and internationally to expand the scope of his research and facilitate the clinical validation of his technology platform (see Exemplar 16). Collaborators also leveraged limited resources to help one another meet their objectives. For example, two AIHS-funded research groups collaborated to develop a decision-support platform for physicians ordering CT scans for the diagnosis of suspected pulmonary embolism. Dr. Eddy Lang (PRIHS) explained the origin of this collaboration:

“

It was discovered that this team [a CRIO team led by Drs. Ghali, Stelfox, and Conly] was working on the development of a digital decision-support platform and database for the work-up of suspected pulmonary embolism, a shared objective with our PRIHS group. Both groups agreed to enter into partnership to develop a single platform for use by both groups, and to avoid competing with each other in implementation.

The core strength that CRIO brings to the partnership is expertise in human usability testing. The core strength that PRIHS brings to the partnership is dissemination to emergency departments through the Emergency Strategic Clinical Network.

Dr. Eddy Lang, PRIHS

”

Investing in trainees is investing in the future of health research. AIHS-funded researchers provide trainees with opportunities to enhance their skills and experiences. Many researchers reported that the multidisciplinary environments they have developed through partnerships with other researchers, industry, policy makers and communities have resulted in unique experiences for trainees to develop the skills they will need to achieve impacts along the continuum of care. Three exemplars of collaborative trainee environments highlight how collaborations with interdisciplinary researchers, industry and policy makers can enhance student training.

EXEMPLAR 6

Engineering the future of health through collaboration

Trainees are benefiting from researchers' collaborative efforts at the University of Alberta.

Dr. Mahdi Tavakoli, a professor in the Electrical and Computer Engineering Department, has teamed up with Drs. Nawaid Usmani and Ronald Sloboda from the Department of Oncology to offer trainees in their CRIO project a wide variety of learning experiences in health sciences (e.g., oncology, medical physics and radiation therapy) and engineering (e.g., device design and instrumentation, control systems, medical robotics and human-machine interaction design) through courses, seminars and workshops.

The trainees have participated actively in various parts of this AIHS-funded project. They receive valuable feedback on their work from clinicians as well as professional engineers and product developers. "This is a crucial milestone both for student training and for putting the various elements of the research in both clinical and industry contexts, which is critical for future translation of the research results into clinic," says Dr. Tavakoli.

EXEMPLAR 7

Developing marketable skills for the knowledge-based economy

Drs. Rajiv Midha and Michael Kallas lead an AIHS CRIO project that aims to genetically modify adult skin cells to create specialized Schwann cells necessary for nerve and spinal cord repair.

If this research is successful, it will mean a patient's own skin cells could be used to treat their nerve or spinal cord damage. This collaborative project brings together four research labs run by Drs. Midha, Kallas, Jeff Biernaskie, and Carol Schuurmans. These principal investigators interact almost daily, work directly in each other's labs, share mentorship of trainees and exchange knowledge, reagents and skills.

"It is our ongoing intention to provide the environment for our trainees to develop highly marketable skills in stem cell biology, bioengineering and regenerative medicine, along with gaining an industry perspective, allowing them to perform leading-edge biomedical research and contribute to Alberta's knowledge-based economy."

This collaborative environment provides trainees with opportunities to engage in multiple disciplines. For example, trainees from the engineering and biomedical labs work together on culture and bioprocess development issues. Monthly meetings of all trainees and the four principal investigators further promote a high level of scientific exchange. Trainees are also provided with opportunities to engage with an industry partner at a full-day research retreat and seminar. This CRIO project plans to establish a fellowship exchange program with its industry partner to give trainees first-hand experience in private sector R&D.

"We aim to provide all trainees the opportunity to acquire state-of-the-art technical and intellectual skills in discovery-based and applied research, preparing them for entry into public or private sector research and development," Dr. Midha says.

EXEMPLAR 8

Highlighting the importance of partnering with policy makers

The Alberta Provincial Pediatric Enteric Infection TEam (APPETITE) studies the viruses and bacteria that cause intestinal infections in children to inform policy makers about the best approaches for diagnostic testing and to provide important evidence to guide vaccine policy.



Funded through an AIHS Team CRIO, this multi-disciplinary research group works closely with policy makers and includes collaborators from the Office of the Chief Medical Officer of Health and Alberta Health Services Medical Officers of Health. The research group also engages health practitioners at clinical sites across Alberta.

Drs. Stephen Freedman, Bonita Lee, Marie Louie and Xiao-Li Pang lead the APPETITE team and provide trainees with the benefit of collaborating with experts beyond their discipline. APPETITE collaborators co-supervise the training program and work closely with trainees to coordinate educational experiences. This is done to ensure the program is tailored to trainees' unique needs. These experiences include rotations/placements at relevant sites (e.g., pediatric emergency departments, public health clinics), a monthly seminar series, an annual research day at which trainees present their work, biannual trainee workshops to foster interdisciplinary collaboration and ensure trainees have the necessary skills to succeed in academic careers, and visiting professorships by International Scientific Advisory Committee members.

“

Vomiting and diarrhea remain one of the most common reasons children aged six to 24 months end up in Canada's emergency departments. These symptoms are extremely worrisome to parents and can, on occasion, lead to life-threatening conditions.

Dr. Stephen Freedman

Nov. 21, 2014, AIHS impact story

”

APPETITE's training program brings trainees from bench to bedside and policy. Trainees have the opportunity to experience how research can impact policy and to appreciate the importance of collaborating with public health agencies and government-appointed officials.

Collaborations Assist in Advancing Knowledge

Researchers established collaborations to exchange expertise and advance the knowledge of the academic community. Results of collaborative studies were shared in numerous academic publications and scientific meetings. Many publications were reported to be in progress or submitted for publication. Some researchers noted that collaboration provided a means to generate hypotheses and new knowledge that cut across traditional disciplinary silos and to integrate multiple perspectives on a health issue.

“

Although the co-leads on this project have historically been involved in the prevention, diagnosis and management of PTLD [Post-Transplant Lymphoproliferative Disorders] in solid organ transplant recipients, we have tended to work largely within our disciplinary silos with a one-patient-at-a-time perspective. The CRIO grant has significantly enhanced our ability to take a comprehensive look at all virology, pathology and clinical outcome data on the historical PTLD cases at our centre, and has also facilitated regular open discussion among our co-leads and collaborators in pathology, virology, immunology, hematology/oncology and adult and pediatric infectious disease.

Dr. Jutta Preiksaitis, ACPLF CRIO

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A collaborative approach has helped improve our understanding of the Hepatitis C infection: specifically its virological , immunological , clinical and behavioral aspects. The collaboration established in recent years with Dr. Naglaa Shoukry is an example of successful translational research. Indeed, evidence has shown that integrating elements related to treatment and adherence has led to important discoveries that are a direct result of this collaboration. Many publications have been produced as a result and the findings have been presented at national and international conferences.

**Drs. Michael Houghton &
Lorne Tyrrell, CRIO Team**

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Collaborations Can Inform Decision Making

A common outcome of the many reported collaborations was informed decision making or activities intended to inform decision making. Researchers worked with their partners to inform the decisions of practitioners, researchers, policy makers as well as patients and the public.

Practice – Collaborations with clinicians and practitioners led to the development, dissemination, implementation and evaluation of clinical guidelines and programs as well as resources and training materials.

Researchers also utilized the Strategic Clinical Networks to draw upon others' expertise on how to inform the decisions of practitioners. The Rectal Cancer Care Clinical Pathway PRIHS research group led by Drs. Todd McMullen, Neil Hagen and Don Buie reported it has learned that the "implementation of [a] clinical pathway and underlying continuous improvement culture on a provincial scale is effective through collaboration with departments mandated to design and implement innovative care at a provincial level (i.e., Strategic Clinical Networks)."

Working closely with research end-users increased enthusiasm for the research and facilitated the translation of research into practice. Partners identified contextual factors that influence health care delivery and the implementation of new practices. Researchers, in turn, used this feedback to develop materials and implementation strategies. Partners also used their connections to disseminate materials and information.

Research – Some researchers reported that they engaged other researchers, stakeholders and end-users in setting research priorities, developing research proposals and informing ongoing studies. Engaging stakeholders and end-users can enhance the relevance of the research, support its dissemination and maximize its impact.

Policy – Researchers reported they shared reports or presentations of their research outcomes with policy makers to inform policy decisions. Some researchers reported that they worked closely with policy makers to understand policy initiatives and relevant health care priorities. Researchers then designed research questions that were relevant and important to policy makers and enhanced the impact of their research.

Patient and Public Awareness – Some researchers reported collaborations with patients and communities. In these collaborations, researchers shared information (e.g., through public presentations and the media) to increase patient and public awareness of their work, provide educational materials and promote enthusiasm for research. An important outcome of these collaborations was patients' and communities' interest in not only participating in the research studies, but also sharing their expertise and experiences to enhance the research and the dissemination of findings.

Informing Decision Making

In the context of health research, the intended purpose of informing decision making is for knowledge that is generated through research activities to be adopted and used by an organization or individuals in order to effect or create health impacts. The impact category of “Informing Decision Making” captures activities that engage appropriate end-users in the translation of research findings into new or revised policies, practices, products or patient, practitioner or public behaviours in order to serve as pathways to improvements in health and wellbeing. Changes in practices include health care, public health, social care and other health-related decisions in areas such as environmental health as well as practices of the health-products industry.

ENGAGEMENT ACTIVITIES

Engagement activities are essentially the means by which researchers meaningfully involve a broad range of stakeholders – patients, consumers, practising clinicians, payers and others – in their research activities.¹⁹ These activities can occur any time during the research process (e.g., identifying the research question, conducting the research or disseminating the research findings).

Increasingly, engagement activities are viewed as critical in helping research meet the needs of stakeholders; be more patient centred, useful and trustworthy; and ultimately lead to greater use and uptake of research findings by patients and other health-related stakeholders.²⁰

Six hundred engagement activities were reported by 49 (71%) researchers. The median number of engagement activities was nine (min=1, max=50). Engagement activities were rarely initiated before the start of the AIHS funding, as only four (1%) of reported activities had done so. Rather, 488 (81%) had occurred either in the same calendar year as the award start year or within the next calendar year, and 108 (18%) were initiated after that.

Numerous types of engagement activities were undertaken by the researchers. The most frequent (n=284, 47%) activity consisted of researchers or members of their research group giving a talk or presentation (Figure 12). Scientific meetings were the second most frequent type of engagement activity, and poster presentations accounted for 57% of the activities at these meetings (Figure 13).

FIGURE 12
Engagement Activities

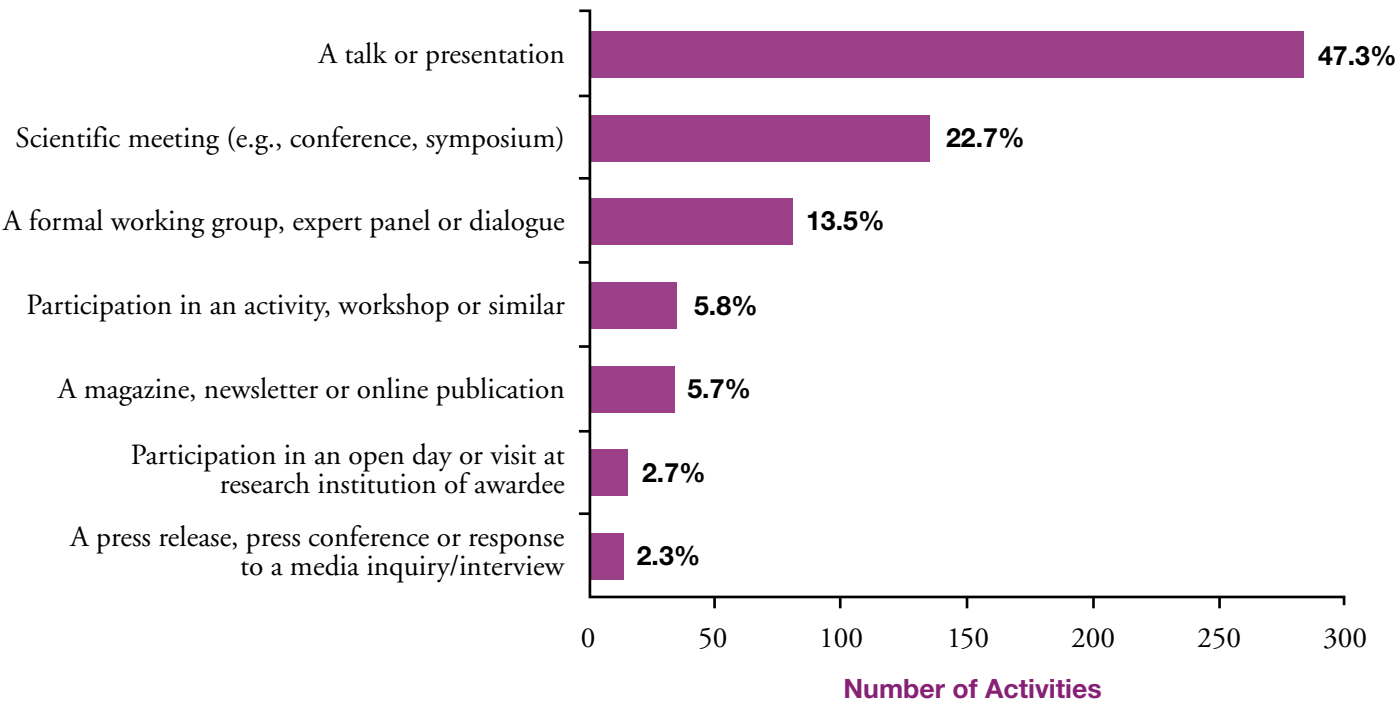
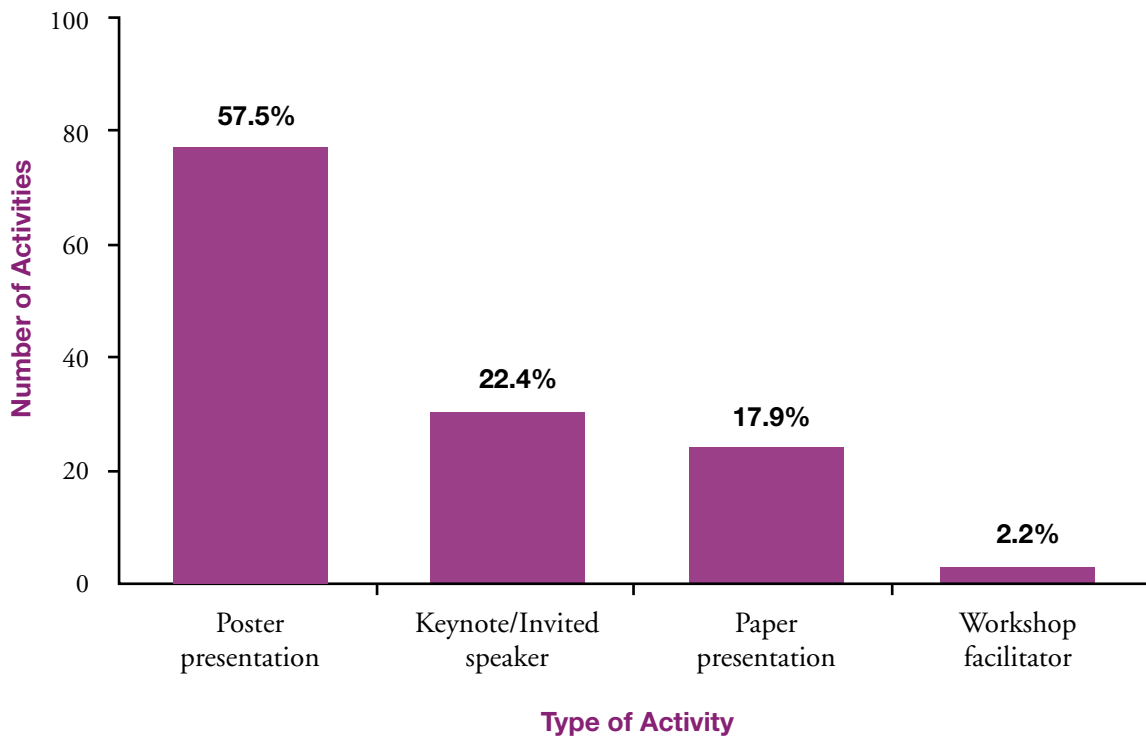


FIGURE 13
Presentations Made at Scientific Meetings



Several researchers support recognized panels or committees and fundraising activities on an ongoing basis as highlighted by a relatively large number (n=177, 37%) of the engagement activities being associated with such activities.

The geographic reach of the reported engagement activities was quite diverse (Figure 14). As illustrated in Figure 14, activities with international reach (n=196, 32.7%) were more frequent than those with local, regional or national reach (n=147, 177 and 88, respectively). AIHS-funded research also reached several different types of audiences through various engagement activities as illustrated in Figure 15. Nonetheless, nearly 60% of those reached consisted of “other” academic audiences (e.g., collaborators, peers) and professional practitioners. Of the reported outcomes that also included the estimated size of the audience reached (n=561, 94%), engagement activities infrequently involved relatively small audiences of 10 people or fewer or substantially large ones of more than 500 people (n=79, 14%).



FIGURE 14
Geographic Reach of Engagement Activities

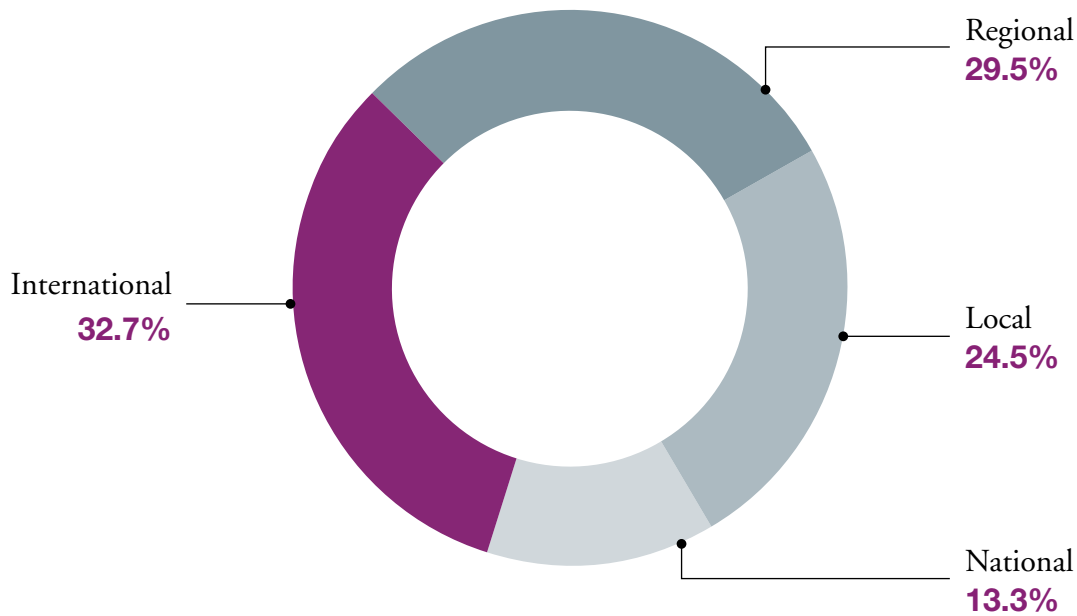
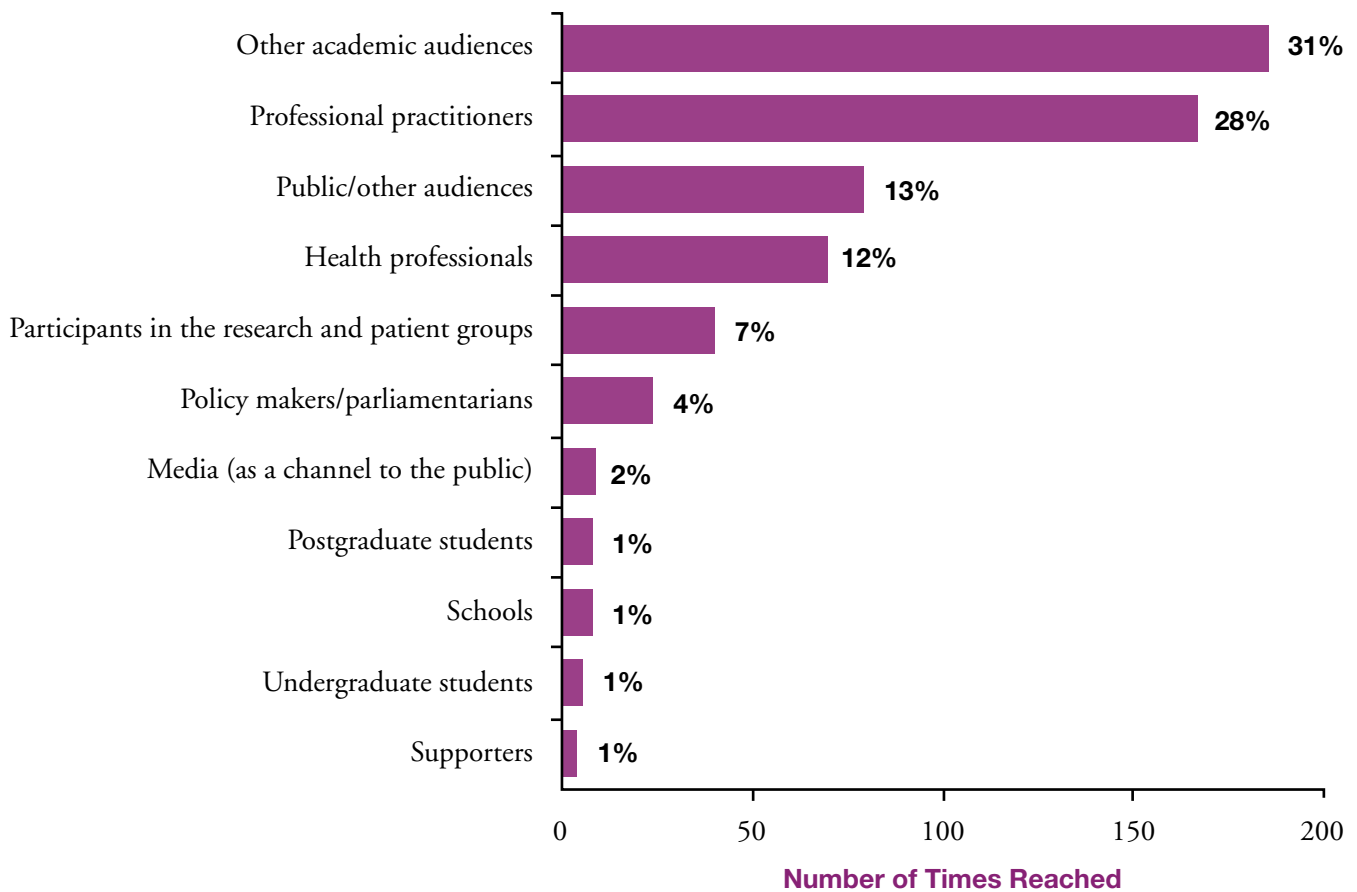


FIGURE 15
Audiences Reached Through Engagement Activities



Engagement activities were, by and large, completed for the main purpose of sharing information with various audiences (n=371, 64%) (Figure 16). It was only on a relatively rare occasion that researchers or members of their research group purposefully engaged with audiences to inform decision making (n=39, 7%) or to assist the research group in making decisions (n=32, 6%). As illustrated in Figure 16, the main purpose of the engagement activities is also reflected in the size of the audiences that were primarily engaged. In particular, larger audiences were engaged more frequently when engagement activities were completed for the main purpose of sharing information or stimulating thinking, whereas smaller audiences were generally engaged when the desired outcome was to inform decision making or to assist the research group in making decisions.



FIGURE 16
Main Purposes of Engagement Activities and Audience Size

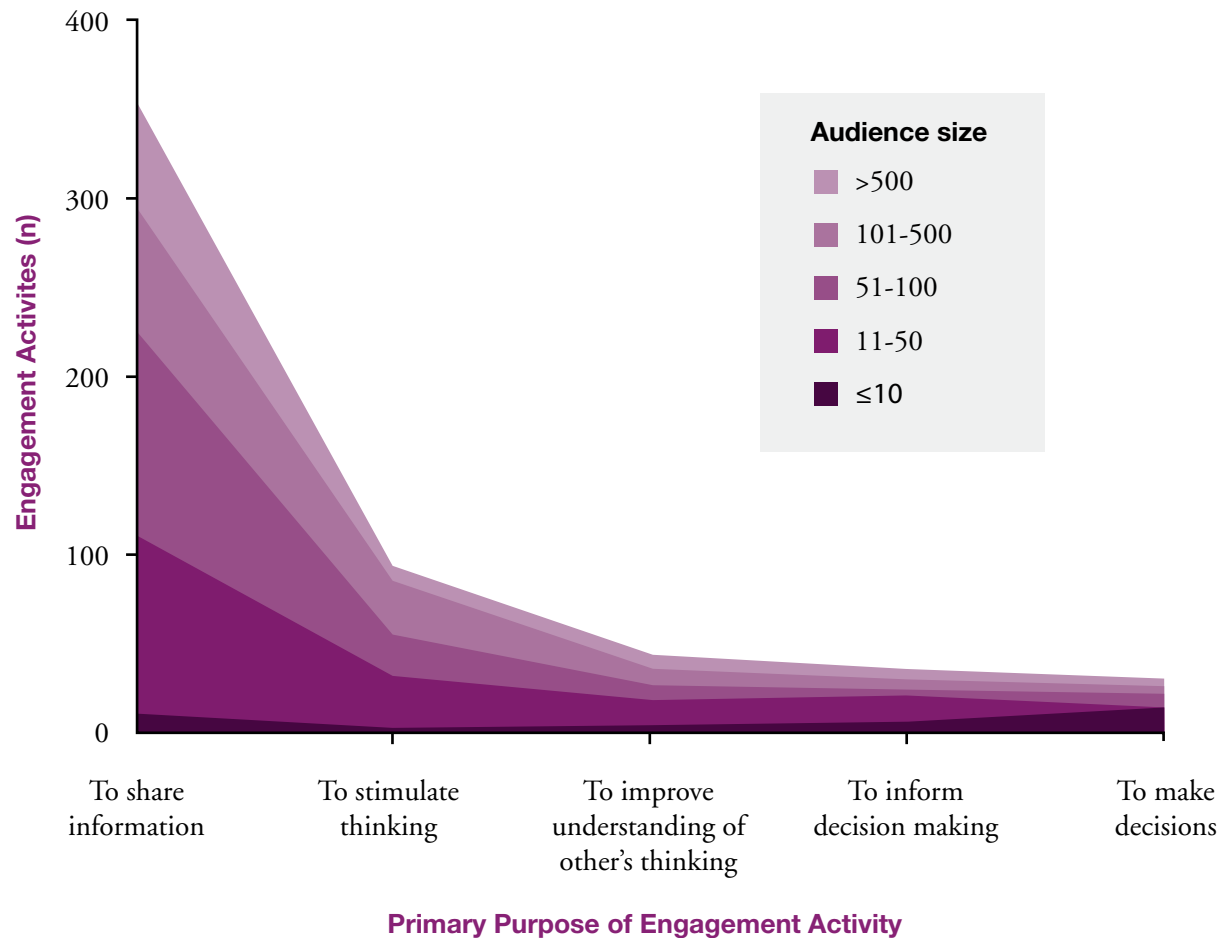
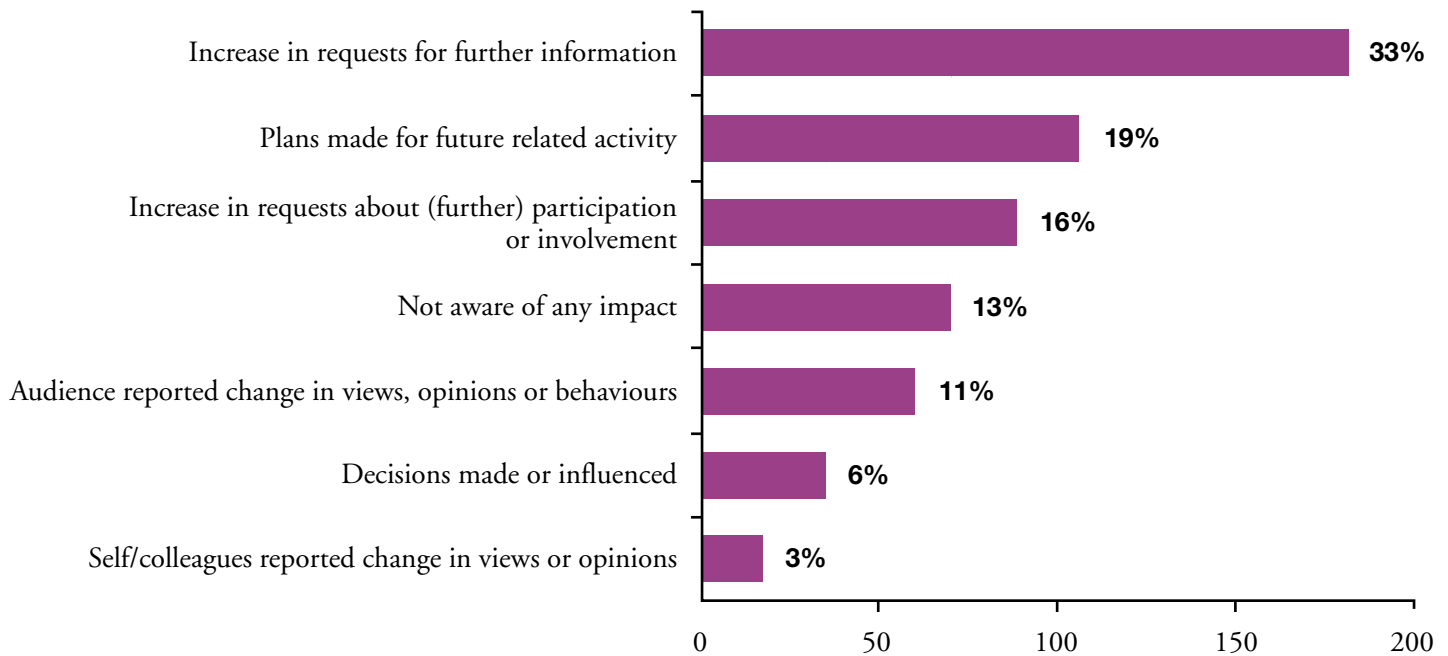


FIGURE 17
Most Important Impacts of Engagement Activities



Of the varied impacts that resulted from the engagement activities to date, researchers considered the three most important impacts to be increased requests for further information (33%), plans made for future related activities (19%) and increased requests about (further) participation or involvement (16%) (Figure 17).

Engagement activities set the stage for achieving impact by bringing stakeholders and particularly end-users of the research together. Five exemplars are highlighted to share how some AIHS-funded researchers have gone beyond the academic community to reach other stakeholders such as practitioners, industry, policy makers, patients and the public. These exemplars also illustrate how these researchers have facilitated connections between these stakeholder communities and have engaged directly with patients. Together, these engagement activities assist in achieving impacts in the areas of capacity, advancing knowledge and informing practice and policy.



EXEMPLAR 9

Researchers and community: Engaging together to fight cancer

Drs. John Lewis and Ronald Moore lead an AIHS-funded CRIO project that is part of the larger Alberta Prostate Cancer Research Initiative (APCaRI). These researchers are demonstrating the importance of engaging the community to build the research capacity to fight prostate cancer.



This CRIO research group has literally opened its doors to stakeholders by offering tours of the APCaRI research laboratory. The researchers also facilitate a biannual symposium and meetings with clinicians, scientists, pathologists, trainees, support group members, philanthropists and clinical research personnel. At these events, research group members present their latest findings in prostate cancer research and include information about ongoing clinical trials, potential collaborations and grant applications. These engagement activities have led to additional collaborations with clinicians and scientists and continued financial support from philanthropists. They have also informed the development of national and international grant applications.

The research group engages throughout the year with its collaborators, stakeholders and end-users online through the APCaRI Web Portal and Knowledge Exchange Hub (<http://apcari.ca/>). The hub is an essential and timely mechanism to disseminate research outputs, exchange information, collaborate and raise funds. “Since its launch in February 2015, over 900 people from all over the world have visited it. We have received multiple applications for jobs, to be enrolled in graduate programs, and to participate in our studies,” Dr. Lewis says.

To date, APCaRI has leveraged \$2 million in research grants from Prostate Cancer Canada and the Alberta Cancer Foundation.

This CRIO research group is very active in the community. They provide seminars to patients in Alberta cancer support groups and participate in community fundraising and prostate cancer awareness events including the Motorcycle Ride for Dad, Movember Campaign, Underwear Affair, 10K Terwillegar Run and the Ride to Conquer Cancer. Community events give members of the CRIO research group the opportunity to update supporters on their research progress and answer questions about how donations support research: “This engages the community and generates a sense of trust between benefactors and the research group,” Dr. Lewis says.

EXEMPLAR 10

Engaging practitioners and patients in using health resources wisely

There is great variability in how often emergency room physicians order CT scans for patients with the same conditions due to pressures from patients and referring physicians. Dr. Eddy Lang's PRIHS research group is looking to reduce this inconsistency by bringing evidence-based decision-support tools into emergency departments. With this goal, the research group developed a digital decision-support platform and database for CT use in the diagnosis of suspected pulmonary embolism.

The impact of this decision-support tool on changing practice will depend on its successful implementation. Dr. Lang's research group recognizes that engaging the practitioners in emergency departments across Alberta is "essential" to implementing this tool into emergency department clinical workflow. The research group has therefore conducted site visits at emergency departments across the province to share evidence on its intervention and gather feedback. This feedback has provided critical insights that assist the researchers in learning how best to integrate the tool into each site's workflow.

Patients also play an important role in changing CT scan practices by reducing the demand for unnecessary scans. Dr. Lang's research group is working with the Alberta Medical Association to co-develop educational materials on appropriate CT use, including brochures for patients with mild traumatic brain injuries, a video on the risks and benefits of CT scans and a public health literacy event through AIHS' Science in the Cinema.

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Every day, emergency physicians across Alberta decide which patient urgently needs diagnostic imaging. They're often under pressure from patients and referring physicians to order advanced imaging like a CT scan.

AIHS impact story, April 21, 2015

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The work being conducted by Dr. Lang's PRIHS research group has the potential to improve health outcomes of Albertans while ensuring more appropriate use of resources within the health system: "Although CT scans can help diagnose many abnormalities, the technology increases the long-term risk of cancer. Plus it's expensive. While we want to be cautious and not miss any abnormalities, we want to use resources wisely," says Dr. Lang. (AIHS impact story, April 21, 2015)

This PRIHS research group includes Drs. Eddy Lang, James Andruchow, Michael Bullard, Derek Emery, Brian Holroyd, Andrew McRae, Brian Rowe and Robert Sevik.

EXEMPLAR 11

More than a drop in the bucket

Dr. Nicholas Ashbolt has played an important role in developing Drinking Water Safety Plans (WSP) internationally. As a member of the Canadian Water Network's technical advisory panel, he is evolving the WSP approach for Alberta's drinking water standards and guidelines. Alberta is the first jurisdiction in North America to implement a Drinking Water Safety Plan, an approach that proactively manages current water infrastructure and contrasts with traditional compliance approaches that are reactive to risks.

Shifting from a reactive to a proactive approach to water management requires a change in culture among policy makers and industry. Dr. Ashbolt has contributed his expertise and promoted the WSP approach on national and international committees to encourage this change in culture and to inform policy and industry practices. In part, this has been achieved through his membership on World Health Organization technical advisory committees for guidance in undertaking quantitative microbial risk assessment (QMRA), which underpins all WHO water-related guidance. He is also a member of the technical group that evaluates household water treatment devices so that companies developing these devices better understand performance against viral, bacterial and protozoan pathogens. These activities complement his 15 years as a lead member of the International Water Association's special interest group on health-related water microbiology that informs water regulators and the water industry globally.

“

Water is our most valued global resource and is intrinsically tied to the health of populations. There is urgency in creating and using knowledge to manage our use and reuse of water for all citizens. Alberta is an ideal place for Dr. Ashbolt to work, share his expertise and mentor others so that our province is a leading centre for best water management research and practice. We're confident that his work will result in safer water for all Albertans.

Dr. Cy Frank, AIHS's late President and CEO

AIHS impact story, April 16, 2014

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In an interview with CBC Radio, Dr. Ashbolt stated that with our growing global population and high costs of maintaining infrastructure, we will be unable to continue our current management and delivery of water services. Recognizing that only 20 percent of our water needs to be potable, Dr. Ashbolt sees a need to look at recycling greywater and using stormwater as alternative urban waters easily treated to fit-for-purpose. His contributions to international efforts to examine the reuse of wastewater and the use of rain and storm waters to inform research and policy include:

- Reviewing a National Academies of Sciences, Engineering and Medicine report that is expected to set the research agenda and national guidance for stormwater use and greywater reuse in North America.
- Contributing to the first international use of WSP for rainwater harvesting as a member of an International Code Council expert panel that is developing standards for rainwater harvesting for home and commercial building use.
- Developing and recommending research projects aimed at improving the understanding of water-borne pathogens in reused water exposure as an elected member of the WateReuse Research Foundation's Research Advisory Committee.
- Developing risk-based treatment requirements for on-site wastewater reuse with North American colleagues through the National Water Research Institute.
- Leading an international greywater workshop to assist researchers in informing policy in relation to the possible microbial risks associated with greywater reuse in urban slums.

The various engagement activities described above have led to changes in people's views and behaviours with respect to water management. Dr. Ashbolt is having an impact on the global management of this most valuable resource by directly engaging policy makers, researchers and industry.

EXEMPLAR 12

Connecting communities around health issues

Alberta Health Services (AHS) wants to make sure patients' voices are heard when they cannot speak for themselves. AHS has implemented a policy to ensure all Albertans 18 years and older are informed about Advance Care Planning (ACP) and Goals of Care Designation (GCD). The ACP process is a way to think about, talk about and document individuals' wishes for health care. The GCD is a medical order that lets health care providers know an individual's general focus and preferred location of care. Together, these interventions open dialogue between patients and their health care providers to ensure the patient's values and wishes are reflected in their health care.



Drs. Neil Hagen, Konrad Fassbender and Jessica Simon lead a CRIO program that is working closely with AHS to study the ongoing implementation of the ACP/GCD policy in Alberta. To share information and inform decision making around ACP, the research group has organized various engagement activities, including webinars, workshops, a Science Café and a multi-day meeting with national and international attendees. Results of these activities include:

- research contributed to the one-year review and evaluation of the ACP/GCD policy
- enhanced medical resident training on the GCD
- collaborations with researchers across Canada
- connections with policy makers that resulted in one policy maker sharing the findings with others, including executive members of the government

Apart from engaging with stakeholders, the researchers have also connected stakeholders with one another:

- The research group brought together AHS, Alberta Health and the Ministry of Human Services to coordinate messaging for a provincial public awareness campaign around ACP.
- Recognizing that aspects of the ACP/GCD policy overlap with legal frameworks, the researchers created opportunities for the health, policy and legal communities to work together around the issue of ACP. This resulted in the establishment of a medical-legal working group to develop ways in which lawyers can assist their clients in engaging with ACP.

These efforts to engage and bring stakeholders together to implement Advance Care Planning is helping establish Alberta as a global leader in this process and ensuring patients have a strong voice in their health care.

EXEMPLAR 13

Connecting patients and researchers

Drs. Jeff Biernaskie PhD and Vincent Gabriel MD lead a patient-oriented CRIO project that aims to improve treatment for burn patients. Their approach has helped patients learn about current research and treatments and also informed researchers' understanding of the patient experience of living with a skin graft.

Through consultations with burn patients and clinicians, the researchers identified the need for a tool for pediatric patients to teach children and their families about the split thickness skin grafting procedure for deep burns. To meet this need, the research group designed and produced a series of animated educational videos describing the skin graft procedure, the biology of skin stem cells and how one's own stem cells might be used to improve the function of a skin graft. One of the videos, called "*What is a skin graft?*", was produced specifically for pediatric burn patients.

The researchers also shared their findings about the patient experience of burn treatment with the research community. Lindsay Burnett, a clinical nurse educator and member of the research group, wrote an article for the academic journal *Burns* on "Patient experiences living with split thickness skin grafts."

This paper describes the experience of patients with split thickness skin grafts to help guide future investigations related to skin regeneration. The American Burn Association named this paper one of the top 10 most influential papers of the year because it highlighted a number of important deficiencies that burn survivors struggle with following skin grafting.

To close the research loop with burn patients themselves, findings of the research project, including work on stem cell-based therapies to regenerate new dermal tissue within skin grafts, were presented to stakeholders such as the burn survivors group and the Calgary Firefighters Burn Treatment Society at their Annual General meeting. This stimulated patients' interest in the group's ongoing and future research and the implications of the research for future burn or scar treatment.



ARTISTIC AND CREATIVE PRODUCTS

Research is inherently creative and this is sometimes reflected in the innovative tools and methods that researchers develop or use to communicate about the development, intentions and/or results of their work. This can be especially true for researchers who work closely with patients, vulnerable populations and communities. The “Artistic and Creative Products” category is used to collect information about these tools and methods and includes products such as artworks, audio recordings, creating writing/performances/films and exhibitions. Books, software and websites are not considered to be valid outcomes in this category and can be captured in other outcome categories.

Four (6%) researchers reported a total of five outcomes that were artistic and creative products (mean=1.24, SD=0.4). Four (80%) of these outcomes were in the form of a film/video/animation while the remaining one (20%) was an artwork. Additionally, two (40%) and three (60%) of the artistic and creative products were produced in the calendar year and second calendar year following award start year, respectively.

INFORMED DECISION MAKING

EXEMPLAR 14

Connecting through creativity

A CRIO research group led by Dr. Karen Goodman successfully uses a community-driven approach to bring together members of northern Canadian communities, their health care providers and scientists.



Johanna Edwards
Logo Contest Winner from Fort McPherson,
Northwest Territories, Canada
Drawing completed 2012
11 years old, grade 5

“

This collection showcases a strong community-researcher partnership in which questions are posed and solutions to health problems are discovered together.

Dr. Karen Goodman

”

The researchers use this approach to share knowledge of how to address concerns about the health burden due to the *H. pylori* bacterium, which causes an infection that can lead to stomach cancer. The approach included an art competition as one means of opening up discussions around research on this health concern within communities. At the start of each of three community projects, Dr. Goodman’s research group invited community members to submit entries for a project logo contest; the logos had to include a visual representation of the *H. pylori* bacterium.

“The drawings capture the imagination and creative spirit of community members. They illustrate community perspectives on a specific health risk and on research aimed at promoting health and wellbeing,” Dr. Goodman says. The contest increased the community members’ enthusiasm for the local project as participants and valued partners, which enhanced the quality and impact of the research.

Research group member Amy Colquhoun (Vanier Canada Graduate Scholar) arranged an exhibit of the logo entries at the University of Alberta that went on to become a permanent installation outside the Centre of Excellence for Gastrointestinal Inflammation and Immunity Research at the university.



SOFTWARE AND TECHNICAL PRODUCTS

The outcome category “Software and Technical Products” collects information about any software or technologies that have been developed for the first time or to a significant new stage, including those that are fully protected and/or public. It also includes technological advances that have made new lines of inquiry possible or that have significantly accelerated research progress. Of note and given the intention of AIHS Annual Impact Reports to be made public, researchers were advised by AIHS and within Researchfish to only disclose details about software and technical products that have been made public, are fully protected or require no such protection; all others were to be excluded from the report in the interest of utmost confidentiality.

One (1%) researcher attributed two web tools/applications to the AIHS-funded award. Both of these were developed in the second calendar year following the start year of the AIHS award.

INFLUENCE ON POLICY, PRACTICE, PATIENTS AND THE PUBLIC

Twenty-four (35%) researchers reported 76 influences on policy, practice, patients and the public (median=1.5, min=1, max=24). The influences can be broadly grouped as being citations in key policy documents (n=16, 21%) and influences on policy-setting processes (n=60, 79%). The most predominant influence in relation to key policy documents was citations in clinical reviews (Figure 18). In terms of influences on policy-setting processes, the training of practitioners or researchers was the most frequent outcome (n=21, 28%), followed closely by participation in an advisory committee (n=19, 25%) (Figure 18).

The majority (n=66, 87%) of influences on policy, practice, patients and the public began within the start year of the funding or subsequent to that (Figure 19). Of the 10 (13%) influences that were first realized prior to the start year of the current AIHS funding, six (60%) were related to the researchers’ participation in an advisory committee and four (40%) from membership on a guideline committee.

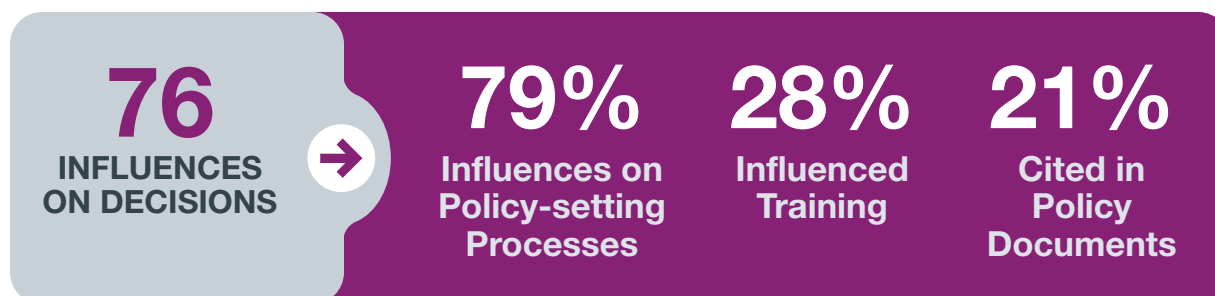


FIGURE 18
Influences on Policy, Practice, Patients and the Public

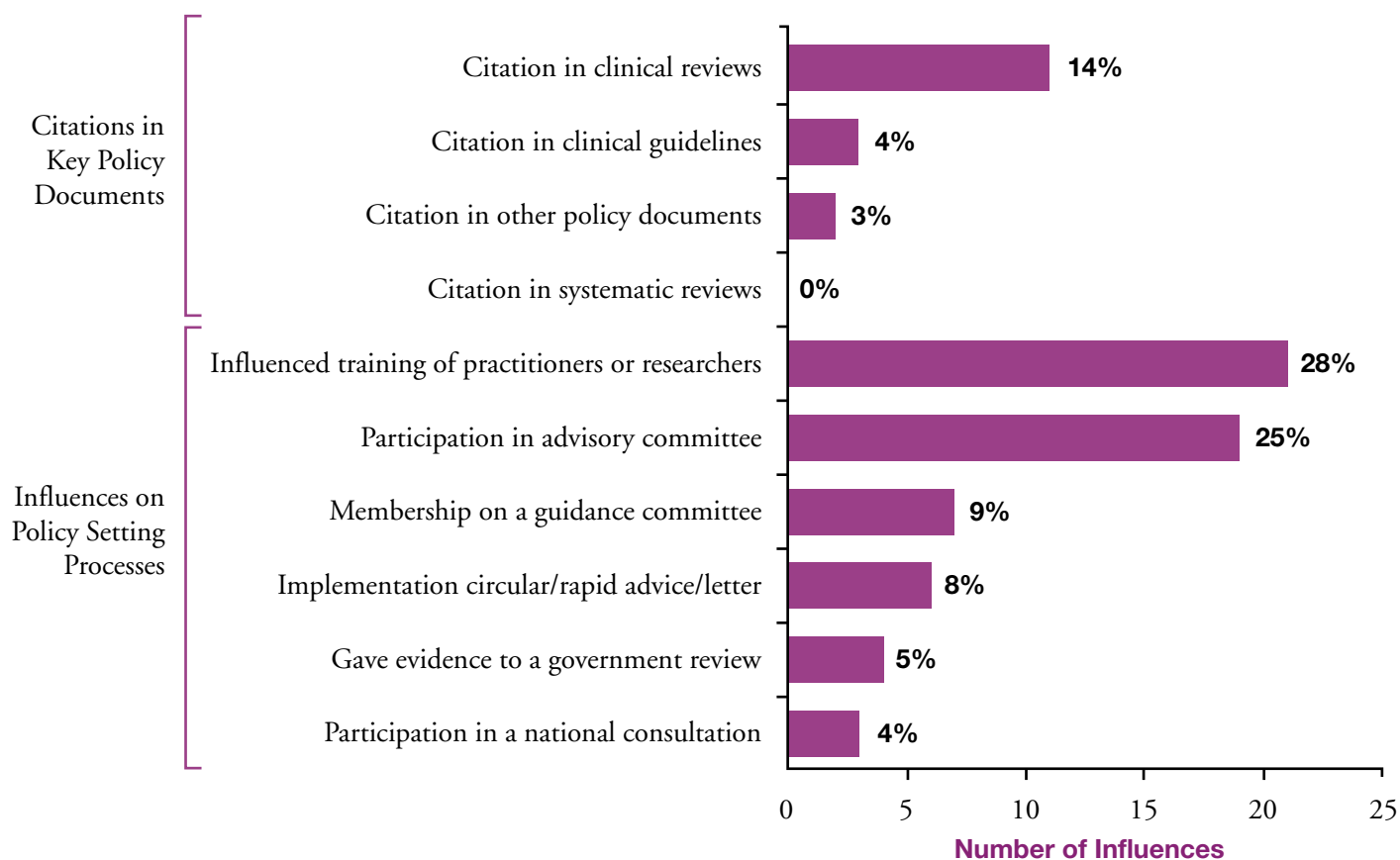


FIGURE 19
Year the Influence on Policy, Practice, Patients and the Public Was First Realized

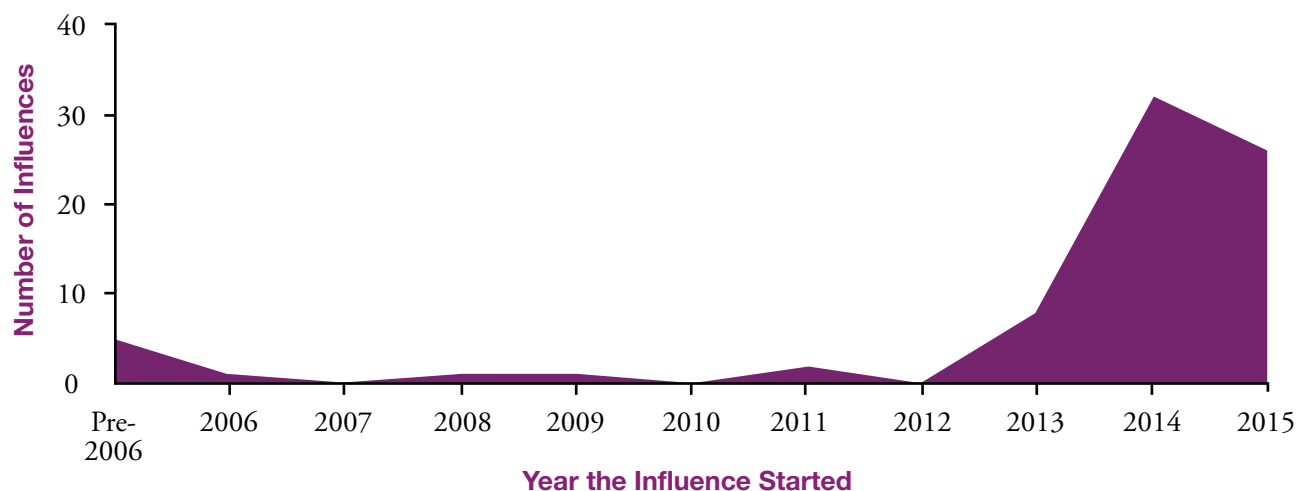
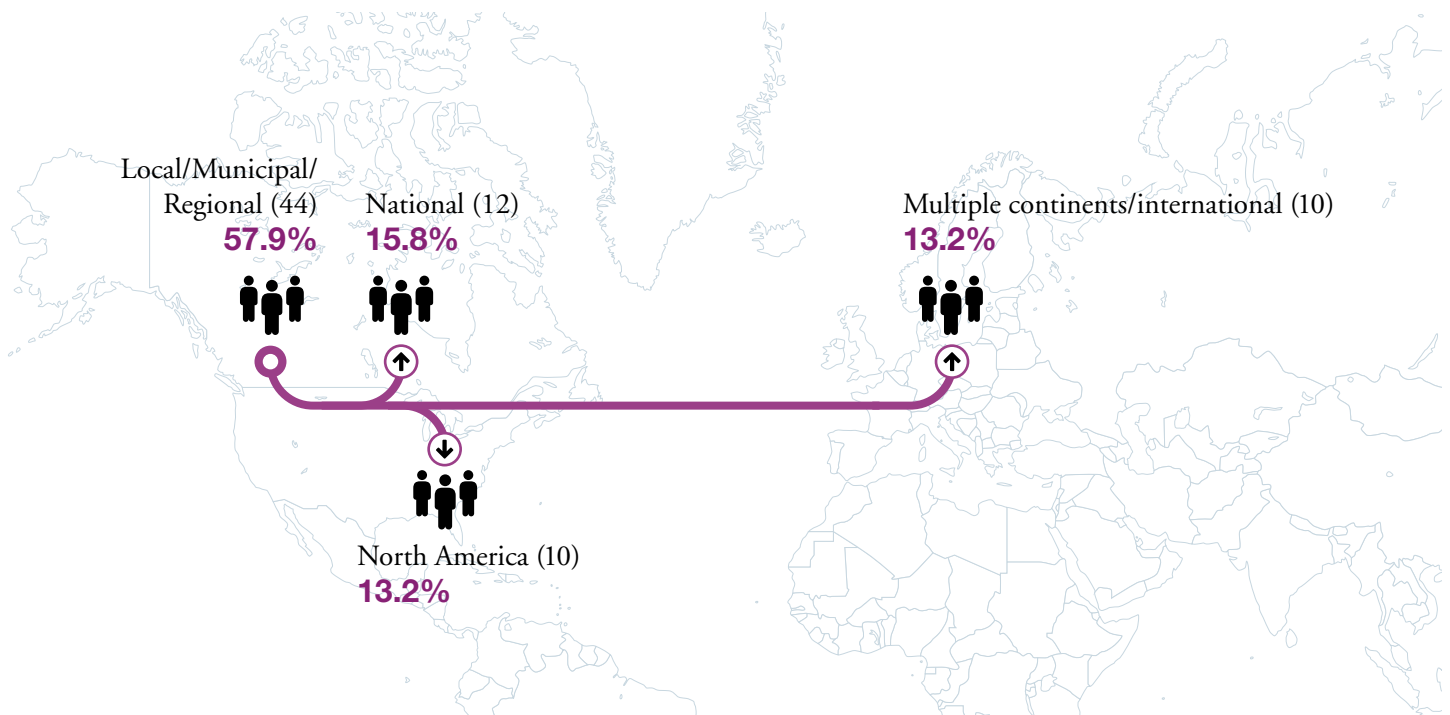


FIGURE 20

Geographic Reach of Influence on Policy, Practice, Patients and the Public



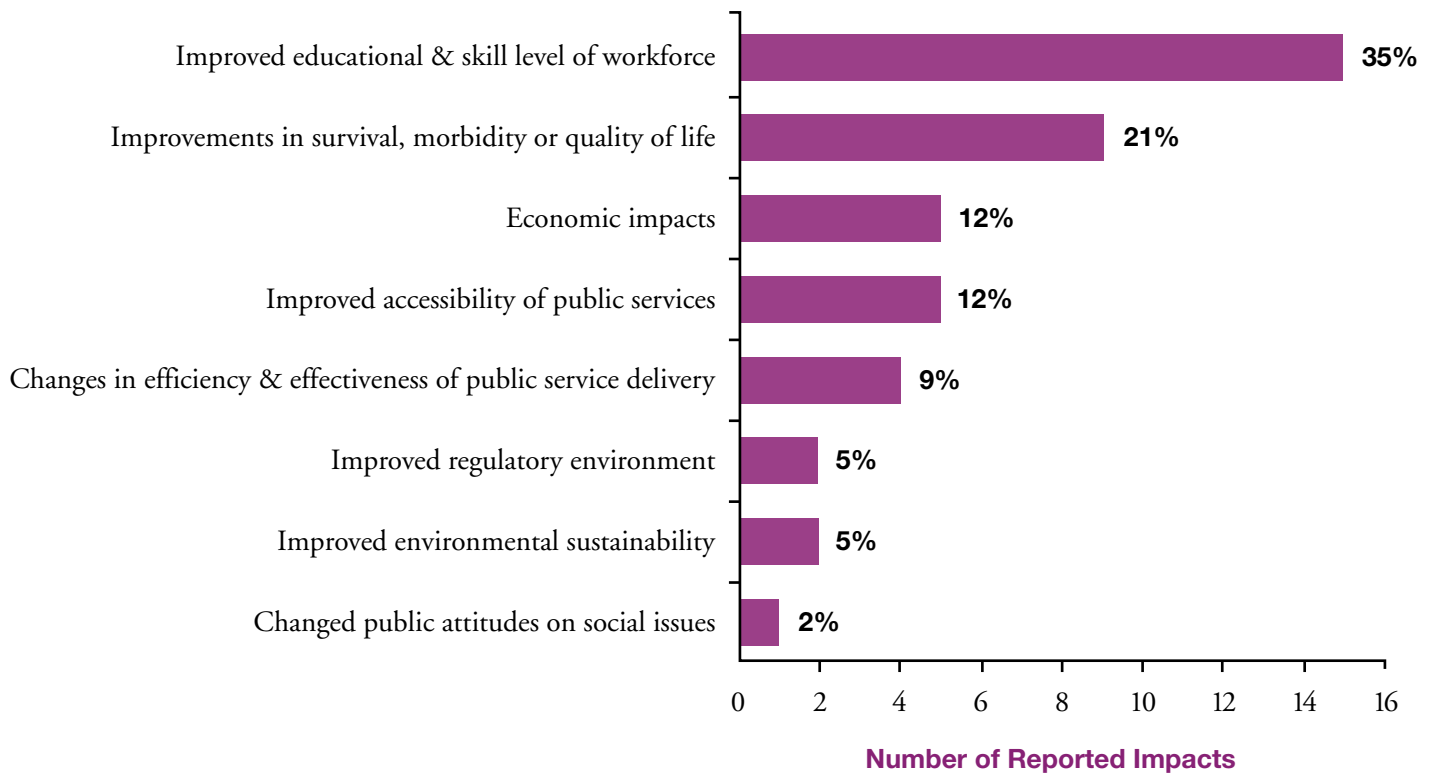
The geographic influence on policy, practice, patients and the public remained primarily within Alberta, accounting for 44 (58%) of the reported influences (Figure 20).

The geographic reach of influences that extended across the provincial border was almost equally distributed among Canada, North America and multiple continents/international (i.e., beyond North America).

A single activity or output can result in multiple impacts. In other cases, the researchers were unaware of any impacts in relation to their activities. Both of these scenarios were evident in the data for influence on policy, practice, patients and the public. In particular, it was reported that the impact(s) of 37 (49%) influences was unknown at the time of reporting. Of the remaining 39 (51%) influences, 12 (31%) had no impacts at the time of reporting while 27 (69%) had at least one reported impact. In this latter group, a total of 43 impacts were reported, the median being two (min=1, max=4). The most frequent impact achieved was improved educational and skill level of the workforce (Figure 21).



FIGURE 21
Impacts of Influences on Policy, Practice, Patients and the Public



Similar to there being multiple impacts arising from a single influence, some influences were also associated with more than one area of policy influence. Health care was the predominant area of policy influence (n=74, 70%) followed by education (n=10, 9%), communities and social services/policy (n=8, 8%) and pharmaceuticals and medical biotechnology (n=4, 4%).



Health Impacts

Health research into causes of disease, methods for prevention, techniques for diagnosis and new approaches to treatment has had a tremendous impact on human health.²¹ It has increased life expectancy, reduced infant mortality, limited the toll of infectious diseases and improved outcomes for patients with acute conditions and chronic diseases such as cancer, diabetes and heart disease.²¹ Although many of the contributions of health research on human health cannot be realized until many years after the funding has ended, several important precursors to those potential impacts on health can occur during the research funding period.

MEDICAL PRODUCTS, INTERVENTIONS AND CLINICAL TRIALS

Health research may involve the development of a wide variety of medical products and interventions and may also involve clinical trials. This outcome category is therefore used to gather information on types and stages of product development, including development of:

- drugs and vaccines
- diagnostic tests, biomarkers and diagnostic imaging techniques
- medical devices
- surgical interventions
- public health interventions
- other medical products that are, or are likely to be, marketed or distributed to a wider audience
- clinical trials
- changes to the status of products or interventions previously reported

Researchers were advised not to disclose any products or interventions that have not been made public or that could not be disclosed prior to protection of intellectual property.

Thirty-one medical products, interventions and clinical trials were reported by 20 (29%) researchers. On average (median), there was one reported outcome by each of these researchers (min=1, max=6). Each reported product, intervention or clinical trial was categorized by the researcher into one of 19 types based on the provided categories and subcategories that best described the outcome (see APPENDIX D). The reported outcomes were distributed across all of the main categories (Figure 22) and consisted of 11 (58%) types of products, interventions and clinical trials overall (Table 7).



FIGURE 22
Distribution of Medical Products, Interventions and Clinical Trials

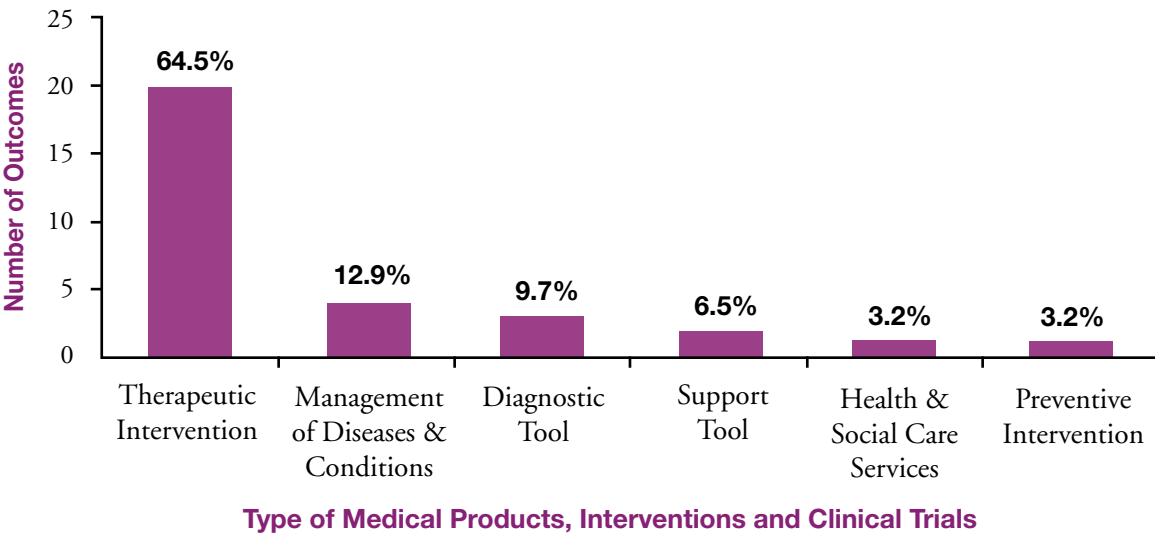


TABLE 7
Distribution of Medical Products, Interventions and Clinical Trials
by Category and Sub-category

Category	Subcategory	Reported Outcomes n (%)
Therapeutic Intervention	Drug	11 (35.5)
	Vaccine	None
	Cellular & Gene Therapy	2 (6.5)
	Medical Device	5 (16.1)
	Surgery	2 (6.5)
	Radiotherapy	None
	Psychological/Behavioural	None
	Physical	None
	Complementary	None
Management of Diseases & Conditions	N/A	4 (12.9)
Diagnostic Tool	Imaging	2 (6.5)
	Non-Imaging	1 (3.2)
Support Tool	For Fundamental Research	1 (3.2)
	For Medical Intervention	1 (3.2)
Health & Social Care Services	N/A	1 (3.2)
Preventive Intervention	Behavioural Risk Modification	None
	Physical/Biological Risk Modification	None
	Nutrition & Chemoprevention	1 (3.2)
Products with Applications Outside of Medicine	N/A	None
Total		31 (100)

The reported medical products and interventions were in various stages of development (Figure 23). As per Table 8, AIHS's investments span the continuum of research, with the 16 (52%) products in the initial or refinement stages largely reflecting discovery and translational science. Experimental medicine is represented by the 14 (45%) products in early- or late-stage clinical evaluations and the one (3%) product being launched onto the market. No outcomes were reported in the development stages of market authorization or wide-scale adoption. It is also noteworthy that 11 (35%) medical products and interventions were being tested with clinical trials.

In terms of development status, 25 (81%) of the medical products and interventions were reported to be in active development or distribution, five (16%) were actively seeking support and one (3%) was on hold.

FIGURE 23

Development Stages Based on Type of Medical Product & Intervention

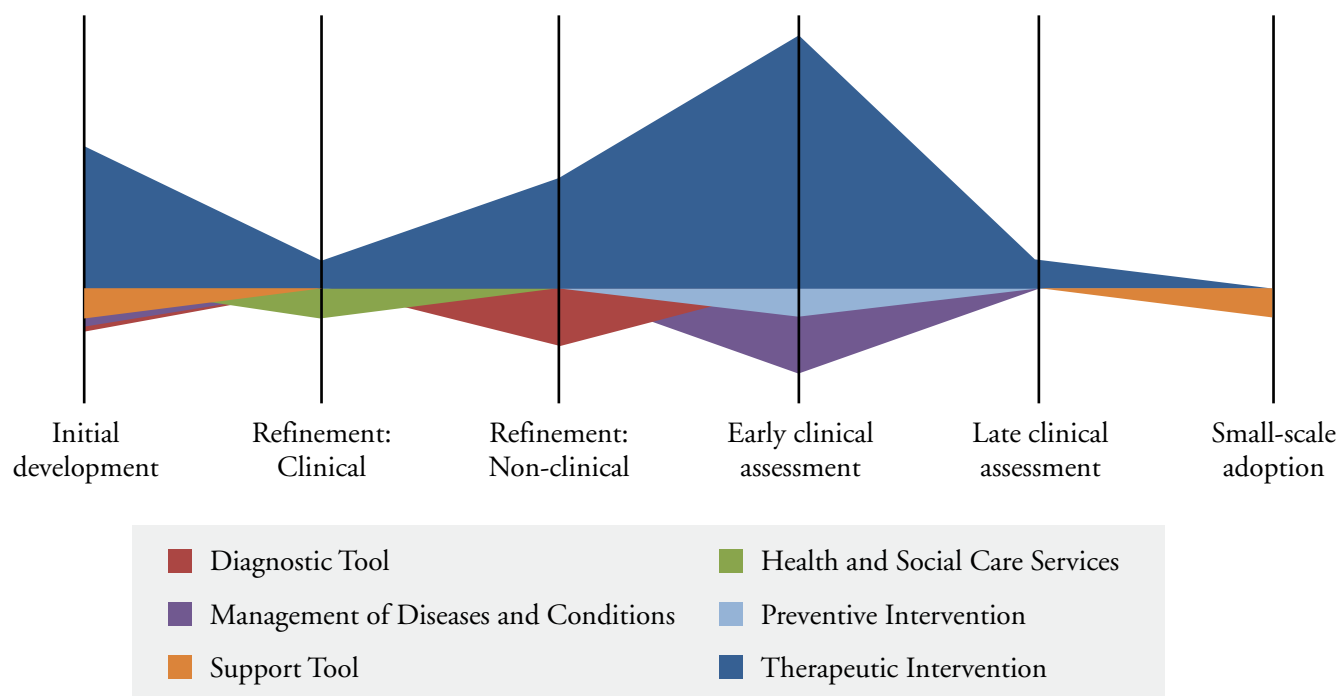


TABLE 8

Development Stages of Medical Products, Interventions and Clinical Trials

Product Type	Development Stage					
	Initial development n (%)	Refinement: Clinical n (%)	Refinement: Non-clinical n (%)	Early clinical assessment n (%)	Late clinical assessment n (%)	Small-scale adoption n (%)
Therapeutic Intervention	5 (16.1)	1 (3.2)	4 (12.9)	9 (28.9)	1 (3.2)	n/a
Diagnostic Tool	1 (3.2)	n/a	2 (6.5)	n/a	n/a	n/a
Health & Social Care Services	n/a	1 (3.2)	n/a	n/a	n/a	n/a
Management of Diseases & Conditions	1 (3.2)	n/a	n/a	3 (9.8)	n/a	n/a
Preventive Intervention	n/a	n/a	n/a	1 (3.2)	n/a	n/a
Support Tool	1 (3.2)	n/a	n/a	n/a	n/a	1 (3.2)
Total	8 (25.8)	2 (6.5)	6 (19.4)	13 (41.9)	1 (3.2)	1 (3.2)

Researchers work to achieve health impacts by improving health status, the determinants of health and the health care system. One of the ways that researchers seek to improve the health care system is by enhancing its accessibility to all Albertans. Accessibility is a challenge for some groups, particularly vulnerable and remote populations. Two research exemplars highlight some of the innovative work AIHS researchers have undertaken to make our health system not only more accessible but also more culturally acceptable and effective.

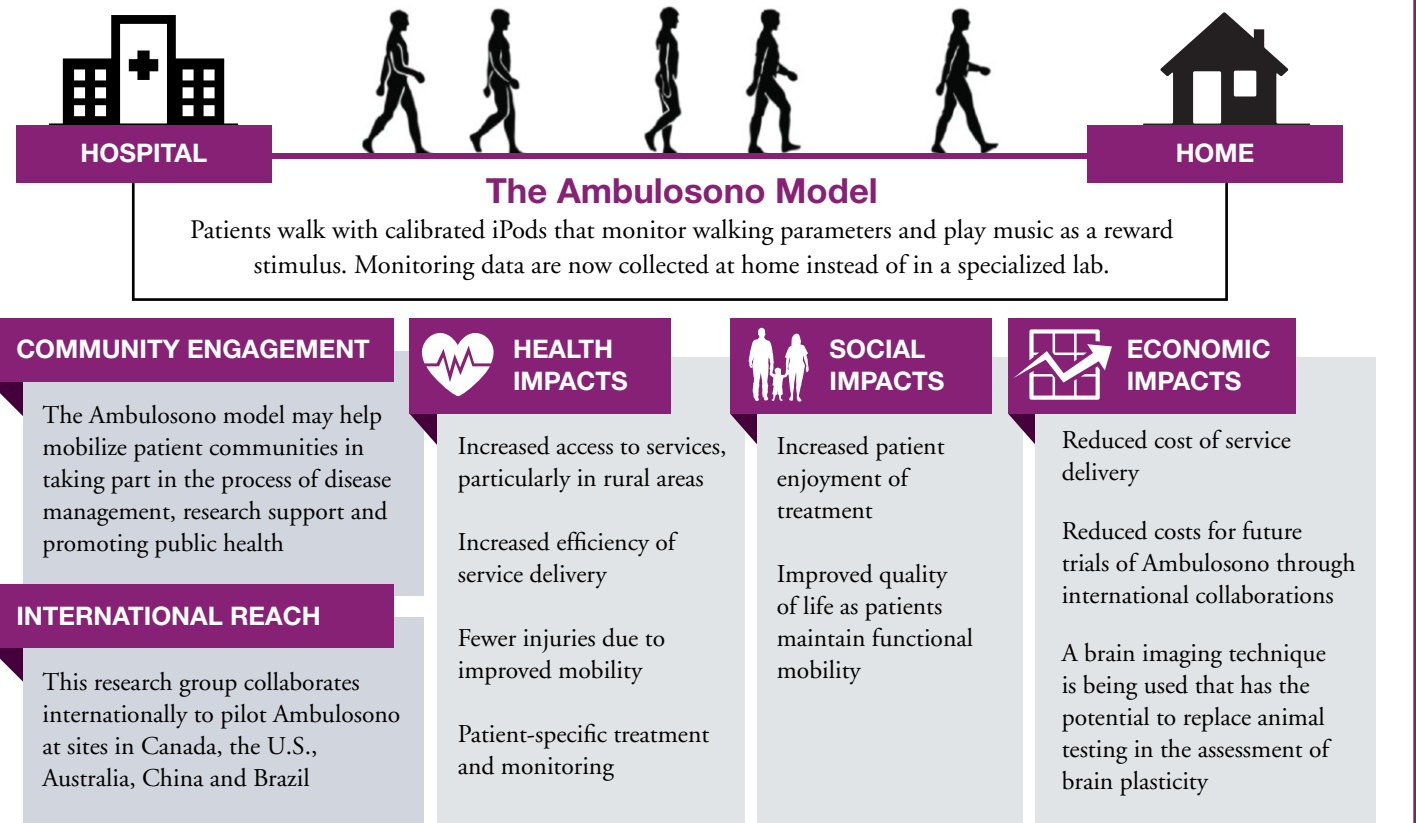
The first exemplar highlights Dr. Bin Hu and the work being done through the CRIO project he is leading to support access to rehabilitation services for patients with Parkinson’s disease in their own homes, which is of particular value to those in rural communities. In the second exemplar, Drs. Sangita Sharma, Carolyn Gotay, Fariba Kolahdooz and Mohammadreza Pakseresht study access to and cultural perceptions of cancer screening, diagnosis and treatment in remote Aboriginal communities through their ACPLF CRIO project.

EXEMPLAR 15

Ambulosono: Technology to Enhance the Continuum of Rehabilitation Care



Parkinson’s disease creates walking difficulties for patients. Effective rehabilitation must be sustained and monitored over a long time. **Dr. Bin Hu leads a CRIO research group and international collaborators to pilot mobile technology that increases service delivery, making advanced rehabilitation services more accessible to patients.**



“The CRIO initiative, under the new leadership of AIHS, has indeed transformed our research mandate from a purely academic pursuit to a new focus on outcomes, community engagement and translational medicine in general.” - Dr. Bin Hu

EXEMPLAR 16

Addressing Cancer Screening in Aboriginal Communities



Access to cancer screening services is critical to cancer care and prevention. This access may be limited and challenging for remote Aboriginal communities in northern Canada. **University of Alberta researchers are working to improve access to these services through the ACCESS Project (Attitudes Towards Cancer in Arctic Communities & Examining Uptake of Screening Services).**

Alberta researchers achieve impacts by...

Engaging with Community Members

Researchers lived in the community and participated in cultural and community events

Collaborating Across Sectors

Community members, researchers, local health care providers and local and territorial governments work together to identify research questions, connect stakeholders and support the research process

Establishing Relationships and Trust with Community Members

"I'm so glad you are here and listen to me" – A participant

In-depth understanding of:

- Aboriginal peoples' perceptions and experiences of health care access and services
- Community members' and health care providers' perspectives on cancer and cancer screening
- Rich culture and traditions of Aboriginal peoples

Evidence to support improvements in:

- Cancer and cancer screening service delivery
- Cultural competence in cancer care

"It's about time. ... 10 years from now, we will be the healthiest community in [this] region." – a community Elder



SOCIAL IMPACTS

Positive relationships between researchers and community support open conversations on an emotional topic.



Improved patient mental and emotional health through stronger community supports, improved care and community voices being heard.



HEALTH IMPACTS

Community has identified concerns and areas for improvement in cancer screening.



Provision of culturally appropriate cancer care. Improved knowledge of and access to cancer screening and care. Improved health of Aboriginal communities.



ECONOMIC IMPACTS

Community members participate as assistants, and ACCESS supports local businesses (e.g., rents facilities and accommodation, provides incentives).

Reduced direct health care costs locally, regionally and provincially. Reduced indirect costs through increased uptake of cancer screening services.

"By developing culturally appropriate programs and implementing sustainable interventions, we hope to impact the prevalence of chronic diseases, including cancer."

- Dr. Sangrita Sharma

Economic and Social Benefits

Improvements in health and the health system can ultimately contribute to broad economic and social benefits.²² Increased productivity of the population as a result of improved health and longevity can make substantial contributions to national economies.^{23,24} Socio-economic benefits can also result from economic activities and commercialization, health benefits measured per health care dollar invested, and social benefits associated with the individual and societal benefits of improved health. Importantly, contributions to economic and social benefits require sufficient time to be realized and this very often occurs long after the period of funding support has ended. Therefore, while efforts are made to collect socio-economic data from funded researchers through monitoring activities such as Annual Impact Reports, it is often the progress along the pathway to these impacts that can be most realistically collected and reported.

INTELLECTUAL PROPERTY AND LICENSING

Intellectual property is any form of knowledge or expression created with one's intellect and includes things such as inventions, software, visual works and trademarks.²⁵ There are different forms of legal protection for different types of intellectual property. In particular, inventions may be protected by a patent, whereas copyright is used to protect software.

Several academic institutions and other stakeholders such as funders have begun to realize the increasingly important role they have in supporting the transfer of intellectual property from academic research to the local community.²⁵ This transfer can lead to local economic developments and a return on publicly funded investments in health research.

Data in the outcome category for “Intellectual Property and Licensing” include patents that have been published, granted or allowed to relapse; discoveries that have been licensed to others; and changes in the status of intellectual property previously reported. Conversely, information related to filed patents should not be reported if (i) the patent is not yet published or (ii) if details of discoveries were to remain confidential.

Ten (14%) researchers reported a combined total of 20 outcomes. These researchers had a median of 1.5 intellectual property and licensing outcomes (min=1, max=5). Twelve (60%) of the reported outcomes involved protection in the form of a published patent application, five (25%) had patents granted and three (15%) were currently copyrighted. There were also five (25%) reports of the intellectual property being formally licensed to others and two (10%) instances where information on formally licensing the IP to others was not provided on the grounds of commercial in confidence.

SPIN OUTS

Management consultant and educator Peter Drucker once said “the best way to predict the future is to create it.”²⁶ It is not surprising then that researchers may take an active role in transforming their ideas and discoveries so that they can be enhanced and applied in society. In so doing, the establishment of new private for-profit or not-for-profit organizations may result in whole or in part through researchers' work. Existing private organizations may also develop strategies and/or turnover directly as an output of funded research. Finally, the research may lead to changes in the status of private sector organizations such as expansions, mergers, acquisitions or dissolution.

The outcome category “Spin Outs” is used to collect the aforementioned information when it relates to the AIHS award except when details are restricted under contractual confidentiality. In brief, the creation of a spin out (or spinoff) organization takes place within an organization that can be an academic institution, a research institute or a firm. Many academic institutions support the creation of these new ventures to assist with the development and exploitation of research-generated opportunities and other achievements such as retaining talent.

One (1%) researcher reported the development of a spin out within the same calendar year as the start of the AIHS funding. At the time of reporting, there were no salaried people employed at the spin out.

As the AIHS-funded research activities highlighted in this report are in early stages, there has been insufficient time for most downstream impacts such as socio-economic impacts to have been achieved. Nevertheless, some researchers report that they are already working with health economists to measure the cost-effectiveness and cost savings of their research. Such evaluations will greatly increase our understanding of the economic impacts of research. Two exemplars are provided below of researchers whose work is leading to early socio-economic impacts. Drs. Leah Gramlich and Gregg Nelson are leading a PRIHS research group that is demonstrating health benefits in terms of actual cost savings to the Alberta health care system for surgery patients. The Alberta Stroke Team, a CRIO team led by Drs. Michael Hill, Ashfaq Shuaib, Andrew Demchuk and Thomas Jeerakathil, is collaborating with stakeholders throughout health service delivery for stroke patients. This team is reporting health impacts with the potential for large-scale savings to health systems worldwide.

EXEMPLAR 17

Enhancing Surgical Care to Deliver Benefits to Patients and the Health System

Each year, 230,000 surgeries are performed in Alberta. Patients often struggle with recovering from surgery. **Drs. Leah Gramlich and Gregg Nelson lead a PRIHS research group to improve recovery times and reduce post-surgery complications and readmission rates.**

This research group introduced the international guidelines for **Enhanced Recovery After Surgery (ERAS)** to Alberta. ERAS is a comprehensive approach to standardize care before, during and after surgery. It reflects international best practices around areas such as nutrition, mobilization, anesthesia and pain management.

With ERAS, patients are well-informed and active members of their care teams. ERAS promotes collaboration, learning and engagement between care providers and patients.

“As a patient, you are no longer lying in bed waiting for something to happen; with ERAS, you know you are expected to participate”

– Registered nurse Katrina Stemmler,
AIHS news release July 27, 2015



“For a relatively small initial investment, ERAS has already saved the health system money: and this is very early days. Our objective is to deliver surgical care sooner, safer and smarter in all areas of the province.”

– Dr. Leah Gramlich,
AIHS news release, July 27, 2015



HEALTH AND ECONOMIC IMPACTS

ERAS is being piloted at the Peter Lougheed Centre (Calgary) and the Grey Nuns Community Hospital (Edmonton) for 690 colorectal surgery patients. Preliminary results included:

- Median length of stay reduced 23% to less than 6 days
- Most types of post-operative complications reduced
- Readmission rates decreased from 16.9% to 8.8%
- Total savings over the 16-month period ending December 2014 estimated to range from \$2,165,726 to \$4,580,915

This pilot has been extended to an additional four hospitals across Alberta.

CHANGING PRACTICE PROVINCIALY

Malnutrition negatively affects post-surgery health outcomes. The research group implemented **Modern Fasting Guidelines** broadly across the system in Alberta as part of ERAS care. Preliminary results support implementing the ERAS guidelines system-wide.

CHANGING PRACTICE INTERNATIONALLY

This PRIHS research group is leading the development of a major gynecology guideline and a head and neck cancer guideline through its collaboration with ERAS Society International.

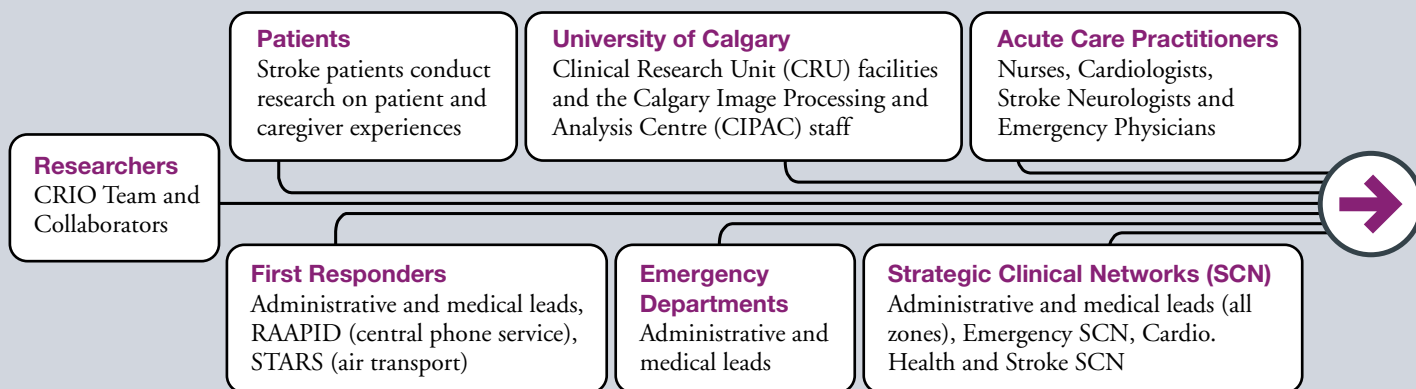
The research group has also advanced knowledge of the clinical and economic outcomes of nutritional and ERAS interventions with the academic community in numerous publications.

EXEMPLAR 18

Collaborating From ‘Door to Needle’ to Implement New Stroke Therapy



The Alberta Stroke Team uses thrombolytic and endovascular treatment (ET) to improve the quality of stroke care. Stroke patients start receiving treatment during transport on specialized ambulances to a stroke centre where ET can be performed. This demonstrates integrated health service delivery in action.



HEALTH IMPACTS

Early treatment of stroke will **improve recovery outcomes** for patients and **reduce death** from strokes. This new therapy is accessible to rural areas, potentially reaching 25% of stroke patients.

*“The overall mortality rate **was reduced from two in 10 patients for standard treatment of care to one in 10 patients** – a 50 percent reduction with ET.”*

– AIHS news release, Feb. 11, 2015



SOCIAL AND ECONOMIC IMPACTS

*“For every stroke you convert from a severe stroke to a mild stroke, you **save the health system a million dollars in lifetime costs**, and you save the patient (from having) a lot of disabilities and return them back to their life.”*

– Dr. Tom Jeerakathil, Edmonton Journal article, July 8, 2015

The team leveraged \$6 million in funding to support this work.

PROVINCIAL APPROACH

Collaboration with Emergency SCN and Cardiovascular Health and Stroke SCN has supported this research with connections, infrastructure, data access and resources.

INTERNATIONAL REACH

Canadian Best Practice Recommendations for Stroke Care published internationally.

*“This breakthrough has the potential to **improve the lives of the 15 million people** who suffer strokes worldwide each year.”*

– Ed McCauley, PhD, vice-president (research), University of Calgary, AIHS news release, Feb. 11, 2015

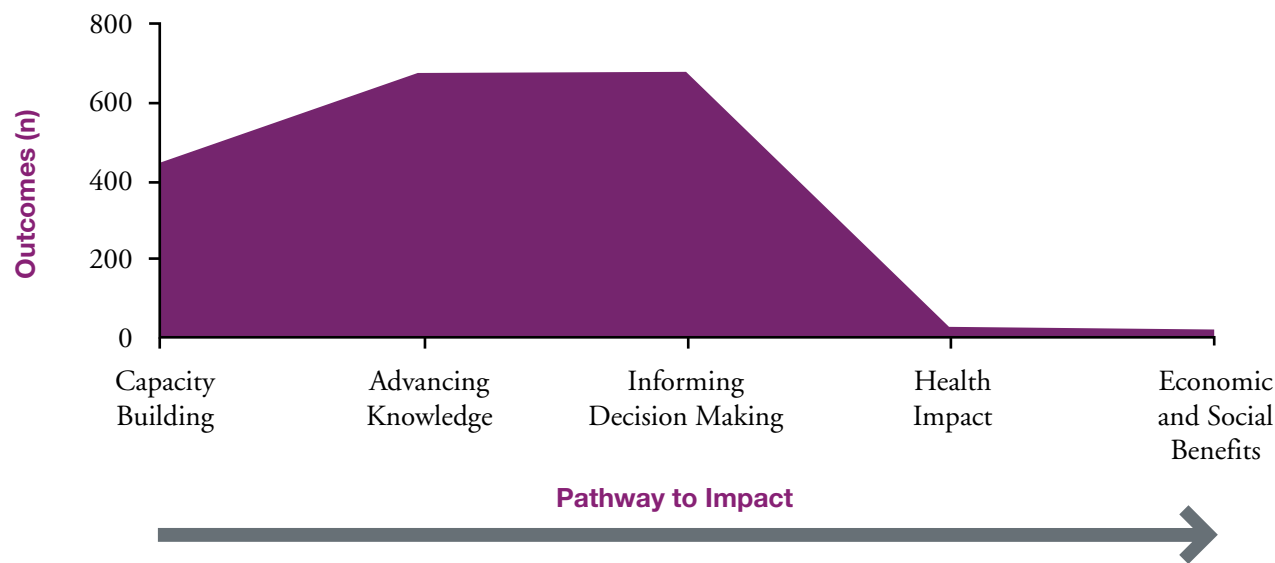
SUMMARY

The impact information reported to AIHS by PRIHS and CRIO researchers and Translational Health Chairs highlights the tangible impacts achieved and progress to impacts being achieved across multiple impact categories.

The AIHS *Health Research to Impact Framework* is highly valuable for clearly illustrating the link between health research and both proximal impacts (i.e., capacity building, advancing knowledge, informing decision making) and distal impacts (i.e., health impacts and social and economic benefits). It also provides a relatively simplistic model for aggregating diverse outcomes into a concise group of impacts in order to illustrate the progress being achieved along the pathway to impact. Mixed method analyses served as a critical means for highlighting the pathway between and across different impact categories. Whereas the quantitative data highlight the breadth and volume of impacts achieved or being realized, it is primarily through qualitative data that the depth, diversity and interrelatedness of impacts and progress can be appreciated.

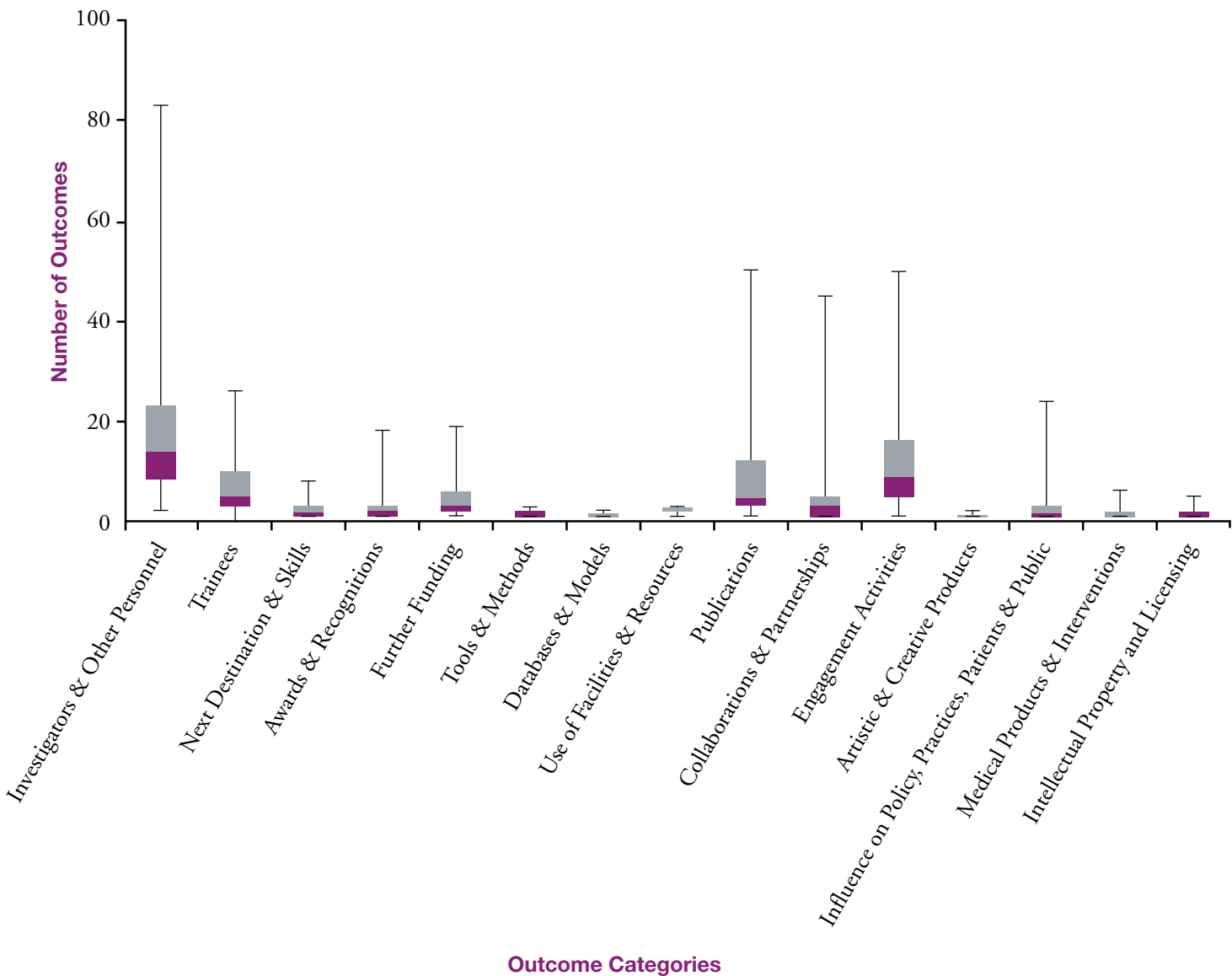
Based on the start date of the AIHS funding, the reported outcomes were achieved within the first 18 months or less of funding and, not surprisingly, coincide with the early part of the pathway to impact (Figure 24). Specifically, as CRIO, PRIHS and Translational Health Chair researchers are in the first and second year of their funding, the outcomes show that much effort has been concentrated on building capacity, advancing knowledge and informing decision making. Importantly, collaborations and partnerships were a key mechanism used to achieve impacts in these categories. It is anticipated that over time, these foundational efforts will lead to health impacts and broad social and economic benefits.

FIGURE 24
Moving Along the Pathway to Impact: Early Outcomes



A summary of the results reported in each outcome category is provided in Figure 25 in the form of a box and whisker plot. This provides a single snapshot of the distribution of the results in 14 outcome categories based on five statistical summaries of the reported number of outcomes. The spread of the data reflects the minimum (bottom horizontal black line) and maximum (top horizontal black line). The median is the point in the box that separates the first quartile (bottom box) from the third quartile (top box). The very limited number of outcomes reported for the categories of “Software and Technical Products” and “Spin Outs” was not conducive for inclusion in this figure.

FIGURE 25
Distribution of Reported Outcomes: Summary



The results outlined in this report emphasize that AIHS's investments in health research continue to contribute to a strengthening of research capacity and other proximal impacts in Alberta. In large part, enhanced capacity is realized in the form of highly skilled people, leveraged funding and infrastructure. Research capacity is also enhanced within and beyond the funded research activities through the development of numerous research materials, tools, methods, databases and models. Enhanced capacity assists in building the essential foundation from which more downstream impacts can be achieved. As well, it provides Alberta and Canada with an opportunity to maintain excellence in health research for years to come. This is partially exemplified by the number of investigators, personnel and staff that remain in Canada after leaving AIHS-funded research activities, as well as the large number of awards and recognitions received by the researchers and their group members in the early stages of the funding cycle. Trainees at all stages of academic progression are benefiting from the funded research activities as per the highly similar proportion of master's students, PhD students and post-doctoral fellows involved in the funded activities. Historical evidence strongly suggests that the leveraged ratio increases throughout the funding because the numerator grows with each additional report of further funding while the denominator remains static (i.e., the total award value provided by AIHS to these individual awards/grants). This ratio will therefore be calculated in subsequent reports when the majority of the researchers are in the later stages of the funding cycle.

A common measure used in relation to the advancement of research knowledge is publication counts. Similar to previous AIHS funding opportunities, a relatively large number of publications – and peer-reviewed journal and review articles in particular – are being produced through the support of AIHS research investments. Collaborations and partnerships are another important means of advancing knowledge, and the evidence indicates that AIHS researchers are highly engaged and collaborative, especially with collaborative partners in Alberta's academic sector. Contributions made both by AIHS-funded researchers and their collaborative partners predominantly consisted of expertise, resources, management and connections. In addition to advancing knowledge, collaborative partnerships contributed to impacts in capacity building and informed decisions in relation to research, practice, policy and patient and public awareness.

This report highlights that AIHS-funded researchers are already informing decision makers despite being in the relatively early stages of the funding cycle. This was largely achieved through engagement activities, one of the most frequent outcomes in this report. By and large, early engagement activities consisted of presentations and scientific meetings for the purpose of sharing information. A relatively small number of engagement activities were intended to inform decision making or to make decisions. At present, it is uncertain whether a shift toward engagement activities for the purpose of informing decision making will occur later in the AIHS funding cycle. This will therefore be monitored through annual impact reports to determine the opportunities and mechanisms used to move research down the pathway toward health and health system impacts. Nonetheless, several researchers reported having had influences on policy, practice, patients and the public and this was mainly accomplished through key policy documents and the training of practitioners or researchers. Quite unexpectedly, a handful of researchers had produced artistic and creative products to communicate with others about the development, intentions or results of their work.

The AIHS-funded research activities in this report are in the early stages of the funding cycle (no more than 18 months since the funding start date). This means that there has been insufficient time for more downstream impacts such as health and socio-economic impacts to be achieved and/or fully realized, especially as these impacts often do not occur until sometime after the funding cycle. Notwithstanding this, nearly one-third of the AIHS researchers have already reported at least one outcome related to medical products, interventions and clinical trials. These outcomes largely consisted of therapeutic interventions that were in the active development stage of early clinical assessment. This coincides with AIHS's rebalancing of its investments across the research continuum to ensure that real improvements are made in the lives of Albertans as exemplified by the objectives of the PRIHS and CRIO funding opportunities. Further, some researchers reported economic impacts in the form of published patent applications and had developed copyrighted materials, while a few others reported having patents granted in relation to the AIHS support. On a cautionary note, however, known time lags between a patent application and the granting of a patent strongly suggest that granted patents reported in the data collection period were associated with earlier research activities and inadvertently reported in association with the PRIHS, CRIO or Translational Health Chair funding opportunity. This will therefore be an important point of clarification for future annual impact reports.

This report was not without limitations. The sole source of data for this report was self-reported by researchers using Researchfish. Apart from validating data related to publications and the number of leads/co-leads and collaborative members, AIHS did not undertake an audit to verify the accuracy or completeness of data. In taking this approach, AIHS assumes that researchers complete the reports to the best of their ability but also recognizes that there is a learning curve related to impact reporting. Overall, the analyses of the quantitative and qualitative data suggest that outcomes were underreported, as some activities that reasonably resulted in multiple outcomes were often not reflected in all related outcome categories. Similar to other jurisdictions, the quality of reporting is expected to increase over time as researchers become more familiar with the information being sought through annual impact reports, the data collection tool and evaluation in general. AIHS views quality impact reporting as a shared responsibility. To improve and accelerate this process, the PME team is committed to assisting the academic community through the provision of focused training and information sessions about monitoring and evaluation and in relation to the electronic impact data collection tool itself (i.e., Researchfish). AIHS will also engage with the research community to co-develop additional impact questions that better align with AIHS business needs (e.g., health impacts).

Underreporting of outcomes may also have resulted from researchers being advised by AIHS and within Researchfish not to disclose restricted or confidential information. For example, it was recommended that information about “Spin Outs,” “Software and Technical Products” and “Medical Products, Interventions and Clinical Trials” not be disclosed when such details were restricted under contractual confidentiality, had not been made public or could not be disclosed prior to intellectual property protection being in place.

Another limitation relates to the mapping of the outcome categories in Researchfish to the impact categories developed by CAHS. This is because some outcome categories could reasonably align to more than one impact category. In such cases, the outcome category was mapped to the impact category where the outcome would most likely have an impact.

Analyses were somewhat limited because this was the first data set generated through the newly implemented electronic impact data collection system. It was therefore not possible to conduct trend or time series analyses. Over time, AIHS intends to illustrate the trajectories from the beginning to end of funding opportunities and beyond and in association with different funding mechanisms. This will help identify the best funding mechanisms for specific strategic objectives designed to meet the needs of the health system.

AIHS will continue its phased implementation of Researchfish and anticipates that all current relevant funding opportunities will be enrolled into Researchfish within 2015. New funding opportunities and additional cohorts of existing funding opportunities will be added to the system on a systematic and periodic basis thereafter. Additionally, AIHS is exploring the possibility of periodic follow-up impact reporting after the end of the funding period in order to capture and report the long-term impacts of health research investments. The PME team at AIHS remains committed to building the evaluation capacity in Alberta and within the academic community in particular. This is best achieved by AIHS and the academic community working in unison to improve the impact of health research and the health research ecosystem in Alberta. Quite simply, AIHS and its academic community are both accountable to the government and the citizens of Alberta for the impacts achieved through the investment of public moneys. Through a collaborative partnership, we can also collectively learn how to optimize the impacts achieved through different funding mechanisms. Information in this report will be shared with the academic institutions where the AIHS-funded researchers are employed. Additional internal reports will also be developed for AIHS for each specific funding portfolio to help strengthen the evidence base for organizational decision making.

As a publicly funded organization, it is essential that AIHS demonstrate that our research investments have resulted in benefits to Albertans and others. Better understanding about what has been achieved from the research that we fund helps us plan our research strategy, ensuring that we are meeting the needs of the health system. It provides evidence to government, the public and others about how AIHS-supported research is delivering health, social and economic gains to Albertans. AIHS’s implementation of a standardized electronic impact data collection tool (i.e., Researchfish) has significantly improved our ability to report on the achievements of the research we support. It also provides AIHS with an unprecedented opportunity to learn more about the effectiveness of specific funding mechanisms in relation to strategic objectives. The next challenge is identifying the best means of measuring downstream impacts, given issues such as data accessibility, attribution versus contribution, and time lags.

For questions related to the content of this report, please contact the Performance Management and Evaluation team at pme@aihealthsolutions.ca.

REFERENCES

1. Government of Alberta, Alberta Advanced Education and Technology & Alberta Health and Wellness. (2010). *Alberta's health research and innovation strategy*. Retrieved from Alberta Innovation and Advanced Education website: <http://eae.alberta.ca/research/initiatives/ahris.aspx>
2. Canadian Academy of Health Sciences. Panel on Return on Investment in Health Research. (2009). *Making an impact: A preferred framework and indicators to measure returns on investment in health research*. [Ottawa]: Canadian Academy of Health Sciences. Retrieved from: http://www.cahs-acss.ca/wp-content/uploads/2011/09/ROI_FullReport.pdf
3. Morgan, B. (2014). Research impact: Income for outcome. *Nature*, 511, S72–S75. doi:10.1038/511S72a
4. Graham, K., Chorzempa, H., Valentine, P., & Magnan, J. (2012). Evaluating health research Impact: Development and implementation of the Alberta Innovates – Health Solutions impact framework. *Research Evaluation*, 21 (5), 354-367. doi: 10.1093/reseval/rvs027
5. Montague, S., & Porteous, N.L. (2013). The case for including reach as a key element of program theory. *Evaluation and Program Planning*, 36(1), 177-183. <http://dx.doi.org/10.1016/j.evalprogplan.2012.03.005>
6. Lang, T., & Secic M. (Eds.). (2006). *How to Report Statistics in Medicine: Annotated Guidelines for Authors, Editors, and Reviewers* (2nd ed.). Philadelphia: American College of Physicians.
7. Medical Research Council. (2014). *Outputs, outcomes and impact of MRC research: 2013/14 report*. Retrieved from: <http://www.mrc.ac.uk/successes/outputs-report/>
8. Merriam, S.B. (2002). *Qualitative research in practice: Examples for discussion and analysis*. San Francisco: Jossey-Bass.
9. Trostle, J. (1992). Research capacity building and international health: Definitions, evaluations and strategies for success. *Social Science and Medicine*, 35(11):1321-1324.
10. National Centre for the Replacement, Refinement and Reduction of Animals in Research (NC3Rs). (2015). *The 3Rs*. Retrieved from NC3Rs website: <https://www.nc3rs.org.uk/the-3rs>
11. Wuchty, S., Jones, B.F., & Uzzi, B. (2007). The increasing dominance of teams in production of knowledge. *Science*, 316 (5827), 1036-1039. <http://dx.doi.org/10.1126/science.1136099>
12. Tacke, O. (2011). Open science 2.0: How research and education can benefit from open innovation and web 2.0. In T.J. Bastiaens, U. Baumol, & B. Kramer (Eds.), *On collective intelligence* (pp. 37-48). Berlin: Springer.
13. Zhou, W., Zou, Y., Zhu, Y., Fei, S., & Lu, X. (2012, September). Wiki lab: A collaboration-oriented scientific research platform. Electronic System-Integration Technology Conference (ESTC), 4th (pp. 411-414).
14. Ynalvez, M.A., & Shrum, W.M. (2011). Professional networks, scientific collaboration, and publication productivity in resource-constrained research institutions in a developing country. *Research Policy*, 40(2), 204-216. <http://dx.doi.org/10.1016/j.respol.2010.10.004>
15. Haustein, S., Tunger, D., Heinrichs, G., & Baelz, G. (2011). Reasons for and development in international scientific collaboration: Does an Asia-Pacific research area exist from a bibliometric point of view? *Scientometrics*, 86(3), 727-746. <http://dx.doi.org/10.1007/s11192-010-0295-4>
16. Van Rijnsoever, F.J., & Hessels, L.K. (2011). Factors associated with disciplinary and interdisciplinary research collaboration. *Research Policy*, 40(3), 463-372. <https://dx.doi.org/10.1016/j.respol.2010.11.001>
17. Wallerstein, N., & Duran, B. (2010) Community-based participatory research contributions to intervention research: The intersection of science and practice to improve health equity. *American Journal of Public Health*, 100(S1), S40-S46. <http://dx.doi.org/10.2105/AJPH.2009.184036>

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- ¹⁸. Bozeman, B., & Corley, E. (2004). Scientists' collaboration strategies: Implications for scientific and technical human capital. *Research Policy*, 33(4), 599-616. <http://dx.doi.org/10.1016/j.respol.2004.01.008>
- ¹⁹. American Institutes for Research. (2012). Innovative methods in stakeholder engagement: An environmental scan (AHRQ Publication NO. 12-EHC097-EF). Rockville, MD: Agency for Healthcare Research and Quality. Retrieved from: <http://www.effectivehealthcare.ahrq.gov/index.cfm/tools-and-resources/how-to-get-involved-in-the-effective-health-care-program/>
- ²⁰. Patient-Centered Outcomes Research Institute. (2014, Feb. 5). What we mean by engagement. Retrieved from <http://www.pcori.org/funding-opportunities/what-we-mean-engagement>
- ²¹. Nass, S.J., Levit, L.A., Gostin, L.O., & Institute of Medicine (U.S.). (2009). *Beyond the HIPAA privacy rule: Enhancing privacy, improving health through research*. Washington, D.C: National Academies Press.
- ²². Figueras, J., & McKee, M. (2012). *Health systems, health, wealth and societal well-being: Assessing the case for investing in health systems*. Maidenhead, Berkshire: McGraw Hill/Open University Press.
- ²³. Hatfield, M., Sonnenschein, H., Rosenberg, L. (2000). *Exceptional returns: the economic value of America's investment in medical research*. Lasker Foundation.
- ²⁴. Murphy K., Topel R. (1999). *The economic value of medical research*. Chicago, IL: University of Chicago Press.
- ²⁵. PARTEQ innovations. (n.d.) Intellectual Property. Retrieved from <http://www.parteqinnovations.com/inventors/intellectual-property>
- ²⁶. Williamson, J.N. (1986). *The Leader-Manager* (p.149). New York: John Wiley and Sons.

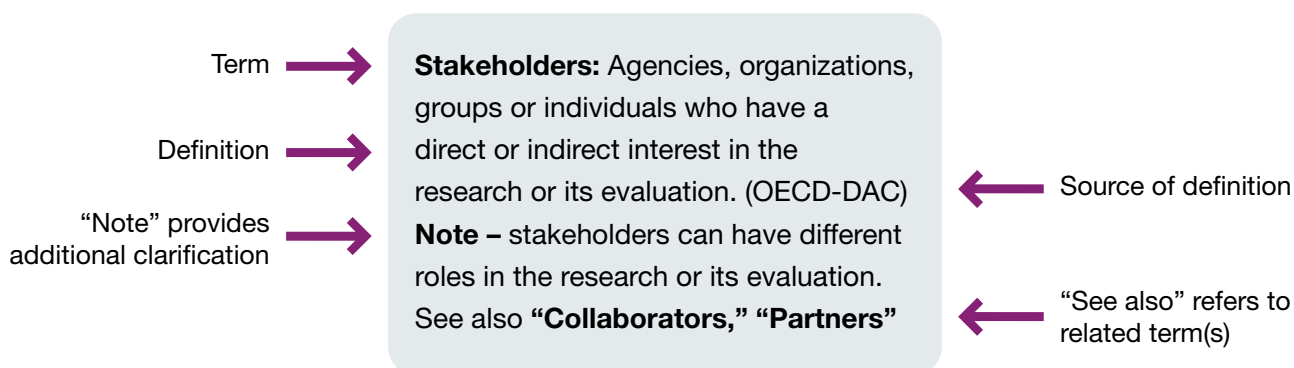
APPENDIX A:

Glossary

The *Glossary* was developed from a collection of terms and phrases in influential glossaries and documents when possible (see Sources). Careful consideration was also given to sources that are relevant on an international and/or national level rather than focusing on regional sources. Alberta Innovates – Health Solutions (AIHS) has developed some definitions to best align with its particular context, experience and existing approach and was therefore used as the source for such definitions.

As illustrated in Figure A-1, the source of each term is referenced after the definition for the term. Where there are terms that can be used interchangeably for a concept, both terms are referenced by including the words “see also” to identify the related term. For additional clarity, the preferred term is also marked with an asterisk (*) in the list of terms in the *Glossary*. Square brackets (i.e., “[]”) were also inserted into the definitions of some terms in order to clarify the meaning provided by the source. If additional clarification was required, a “note” was placed after the definition and source.

FIGURE A-1
Anatomy of a definition



Advancing knowledge: The process and mechanisms used to move knowledge beyond the researchers so that it creates awareness, understanding and opportunity to guide the decisions and actions of policy and decision makers, practitioners, patients and/or the public. (AIHS)

Assessment: A synthesis of facts, which arise from the evaluation process, and judgments. (ETAN Expert Working Group)

Collaborators*: The individuals and/or organizations that collaborate to achieve mutually agreed upon objectives. (OECD-DAC)

See also **“Partners,” “Stakeholders”**

Evidence-based decision making: A philosophy of management that emphasizes the importance of using defensible evidence as a basis for making decisions – sometimes associated with performance management. (McDavid et al.)

Indicator*: A variable that measures a phenomenon of interest to the evaluator. The phenomenon can be an input, an output, an outcome, a characteristic or an attribute. (World Bank)

Note – [an indicator can be either] a quantitative or qualitative factor or variable that provides a simple and reliable means to measure achievement, to reflect the changes connected to an intervention, or to help assess the performance of a development actor. (OECD-DAC)

Impact: Positive and negative, primary and secondary long-term effects produced by an intervention, directly or indirectly, intended or unintended. (OECD-DAC)

Note – specific frameworks and tools describe impact differently; e.g., CAHS equates impact to outputs and outcomes, whereas logic models equate impact to outcomes and/or to long-term outcomes. See also “Outcome,” “Output”

Impact assessment*: Assesses the changes that can be [linked] to a particular intervention, such as a project, program or policy – both the intended ones as well as, ideally, the unintended ones. Many [impacts] of programs are influenced by external factors, including other national, regional and local programs and policies, as well as economic or environmental conditions. Thus, the [impacts] observed typically reflect a combination of influences. Correspondingly, the central challenge in carrying out effective impact evaluations is to identify the causal relationship between the project, program or policy and [subsequent impacts]. (ISRIA 2014, World Bank 2011, GAO 2012)

Impact evaluation: See “Impact assessment”

Informing decision making: The adoption and use of knowledge either by an organization or individual end-users to effect or create policies, practices, products or behaviours that can serve as pathways to improvements in health and the health system. Changes in practices include health care, public health, social care and other health-related decisions in areas such as environmental health as well as practices of the health-products industry. (AIHS)

Monitoring: A systematic process of collecting and recording information on the progress and direction of ongoing actions, generated mainly for management purposes. (ETAN Expert Working Group)

Outcome: Changes or benefits resulting from activities and outputs. Short-term outcomes produce changes in learning, knowledge, attitude, skills or understanding. Intermediate outcomes generate changes in behaviour, practice or decisions. Long-term outcomes produce changes in condition. (EPA)
See also “Impact”

Output: The products or results of the process. These might include, for example, the number of people a project has affected, their ages and ethnic groups or the number of meetings held and the ways in which the findings of the project are disseminated. (WHO)
See also “Impact”

Partners: The individuals and/or organizations that collaborate to achieve mutually agreed upon objectives. (OECD-DAC)
See also “Collaborators,” “Stakeholders”

Performance management: The systematic process of monitoring the achievements of program activities; collecting and analyzing performance information to track progress toward planned results; using performance information and evaluations to influence decision making and resource allocation; and communicating results to advance organizational learning and communicate results to stakeholders. (USAID)

Research impact assessment (RIA): Assesses the changes, both intended and unintended, that can be linked to a particular research program (e.g. funding, intervention, portfolio). (ISRIA 2014)
See also “Impact Assessment”

Research infrastructure: Facilities, resources and related services used by the scientific community to conduct top-level research in their respective fields and that consist of a single resource at a single location (“single-sited”), a network of distributed resources (“distributed”) or services provided electronically (“virtual”). Examples include singular large-scale research installations, collections, special habitats, libraries, databases, biological archives, clean rooms, integrated arrays of small research installations, and high-capacity/high-speed communication networks. (European Commission).

Stakeholders: Agencies, organizations, groups or individuals who have a direct or indirect interest in the research or its evaluation. (OECD-DAC).

Note – stakeholders can have different roles in the research or its evaluation.
See also “Collaborators,” “Partners”

Value for money: The optimal use of resources to achieve the intended outcomes. (NAO)
Note – different frameworks and performance management systems can be defined differently. For example, the Treasury Board of Canada associates value for money with relevance and performance (Treasury Board of Canada Secretariat).

**Preferred term where there are terms that can be used interchangeably for a concept*

Sources

Alberta Innovates – Health Solutions (AIHS). 2015.

Environmental Protection Agency (EPA). 2007. *Program evaluation glossary*. Office of the Administrator, Office of Policy, Office of Strategic Environmental Management, Evaluation Support Division. http://ofmpub.epa.gov/sor_internet/registry/termreg/searchandretrieve/glossariesandkeywordlists/search.do?details=&glossaryName=Program%20Evaluation%20Glossary

European Commission: European Research Area. 2015. *Advancing Knowledge. European Infrastructures and e-Infrastructures*. https://ec.europa.eu/research/infrastructures/pdf/leaflet_web_en.pdf

European Technology Assessment Network (ETAN) Expert Working Group. 1999. *Report to the European Commission, Options and Limits for Assessing the Socio-Economic Impact of European RTD Programmes*. <ftp://ftp.cordis.europa.eu/pub/etan/docs/master-impact.pdf>

Government Accountability Office (GAO). 2012. *Designing evaluation*. (GAO-12-208G). <http://www.gao.gov/assets/590/588146.pdf>

International School on Research Impact Assessment (SRIA). 2014. Glossary. <http://www.theinternationalschoolonria.com>

McDavid, J.C. et al. 2013. *Program evaluation and performance measurement: An introduction to practice*. Los Angeles: Sage.

National Audit Office (NAO). 2014. *What is a value for money study?* <http://www.nao.org.uk/about-us/what-we-do/value-for-money-programme/what-is-a-value-for-money-study/>

Organisation for Economic Co-operation and Development, Development Assistance Committee (OECD-DAC). 2002. *Glossary of Key Terms in Evaluation and Results Based Management*. <http://www.oecd.org/development/peer-reviews/2754804.pdf>

United States Agency for International Development (USAID). 2011. *USAID Evaluation policy*. <http://www.usaid.gov/sites/default/files/documents/1868/USAIDEvaluationPolicy.pdf>

World Bank. 2011. *Impact evaluation in practice*. <https://openknowledge.worldbank.org/handle/10986/2550>

World Health Organization (WHO). 2013. *Health impact assessment: Glossary of terms used*. <http://www.who.int/hia/about/glos/en/index.html>

APPENDIX B:

Reporting Periods of the Funding Opportunities Included in the AIHS Annual Impact Report: 2014-15

Data for the AIHS Annual Impact Report: 2014-15 were collected through the first phase of implementation of AIHS's new electronic impact data collection system (Researchfish). This initial implementation occurred in April 2015 and involved researchers supported through Collaboration Research and Innovation Opportunities (CRIO), Partnership for Research and Innovation in the Health System (PRIHS) and Translational Health Chairs. As highlighted below, not all reported impacts were limited to activities and outcomes that occurred in the 2014-15 fiscal year (i.e., April 1, 2014, to March 31, 2015) because some of the researchers had not previously submitted impact data to AIHS and had funding start dates prior to April 1, 2014.

As AIHS proceeds with the phased implementation of Researchfish, more researchers funded through newer cohorts of these and other funding opportunities will be enrolled into this system. For newly enrolled researchers and funding opportunities, the first year of reporting will be from the award start date to March 31 of the same fiscal year as we are moving toward a single annual submission period (April) in which funded researchers will be required to submit their completed Annual Impact Report to AIHS.

Subsequent years will reflect outputs, outcomes and impacts achieved in each respective fiscal year, with final reports being from April 1 to the end date of funding or, if an extension was granted, to the end date of the extension.

Funding Opportunity & Award Start Date	Reporting Period	Length of Reporting Period
Partnership for Research and Innovation in the Health System (PRIHS) PRIHS with award start date of January 1, 2014	Award start date (i.e., January 1, 2014) to March 31, 2015	15 months
Translational Health Chairs (THC) Translational Health Chairs with award start dates of April 1, 2014, and earlier	Award start date to March 31, 2015	Variable (15 months and 18 months)
Collaborative Research and Innovation Opportunities (CRIO)		
A. CRIO Team, Program and Project awards with start date of April 1, 2013	A. April 1, 2014, to March 31, 2015 (Note: report for April 1/13 to March 31/14 was previously submitted)	A. 12 months
B. CRIO Team awards with start date of April 1, 2014	B. Researchfish will be used to report impacts achieved between April 1, 2014, and March 31, 2015	B. 12 months
C. CRIO Project Cancer awards with start date of March 28, 2013	C. March 28, 2014, and March 31, 2015.	C. Approximately 12 months
D. CRIO Project Cancer awards with start date of March 28, 2014	D. Researchfish will be used to report impacts achieved between April 1, 2014, and March 31, 2015	D. Approximately 12 months

APPENDIX C:

Leveraged Ratio Calculation

The leveraged funding ratio is the quotient of the sum of further funding attracted excluding further funding provided by Alberta Innovates – Health Solutions (AIHS) divided by the sum of the AIHS award values committed (see below). For this calculation and the reporting of leveraged funding amounts in general by AIHS, “further funding attracted” is the leveraged funding reported to AIHS by its researchers and is limited to (i) funding that was received after the start date of AIHS funding, (ii) funding that was received before the end of that funding period; and (iii) funding that was obtained from funders excluding AIHS to avoid circularity in the leveraged calculations.

The amount of further funding reported to AIHS coincides with the award value that was committed (pledged) to the researcher by the funding organization and not the actual amount of funding already received from that funder. Similarly, “AIHS award values committed” are the award values as per the Notification of Award to each researcher. This is different from the amount of money actually expended (invested). For the calculation, the use of AIHS award values “committed” is preferable to the use of “AIHS investments” because researchers report the award value committed by AIHS (and other funding organizations) on subsequent funding applications. It is therefore the award value – not the actual amount invested by AIHS at the time of that subsequent application – that is used to inform the funding decision of the committee reviewing the funding applications.

The “AIHS award value committed” does not change for a researcher during the funding cycle. However, it is generally observed that the amount of “further funding attracted” by researchers increases in the mid and latter stages of the funding cycle. This pattern relates, in part, to time lags in applying for further funding, the funding review process and learning of the funding decision. As a result, the leveraged funding ratio tends to increase annually when analyzed at the level of a funding portfolio.

$$\text{Leveraged funding ratio} = \frac{\text{Sum of further funding (\$) attracted}}{\text{Sum of AIHS award values (\$) committed}}$$

APPENDIX D:

Types of Medical Products and Interventions

The following table contains key information provided in the Types of Product/ Intervention guidance provided by Researchfish.

Category	Subcategory	Description
Diagnostic Tool	Imaging	<ul style="list-style-type: none"> • Radiography (MRI, X-rays) • Nuclear medicine • Endoscopy • Medical thermography • Medical Photography • Ultrasound • Microscopy • Measurement and recording techniques that are not primarily designed to produce images but that produce data susceptible to be represented as maps (e.g., EEG, MEG, EKG, etc.)
	Non-Imaging	<ul style="list-style-type: none"> • All diagnostic approaches not focused on imaging modalities and includes genetic, biomedical and physical tests or assays with the potential to be used diagnostically
Therapeutic Intervention	Drug	<p>Development of pharmaceutical drugs with the potential to treat or to alleviate the symptoms of disease. Includes:</p> <ul style="list-style-type: none"> • Small-molecule drugs • Hormones • Biologics (e.g., peptides, oligosaccharides, therapeutic antibodies and recombinant proteins) • Delivery of drugs (approaches to modify the release, absorption, distribution or elimination of drugs and ways to administer drugs e.g., inhalation, injection, etc.)
	Vaccine	<ul style="list-style-type: none"> • Developments focused on inducing an immune response with the aim of prevention (e.g., antibacterial or antiviral vaccines) or therapy (e.g., therapeutic cancer vaccines) <ul style="list-style-type: none"> • Does not necessarily include therapies that involve components of the immune system (e.g., therapeutic monoclonal antibodies) • Approaches to deliver vaccines (e.g., skin-patch delivery systems; plasmid approaches to vaccination)
	Cellular & Gene Therapy	<ul style="list-style-type: none"> • Developments involving the insertion of genetic material into the cell whether using a viral (e.g., adenovirus) or non-viral (e.g., liposomal) vector or no vector at all (naked DNA) • siRNA and oligonucleotide approaches • Development of systems to deliver genetic material, siRNAs and oligonucleotides (e.g., new viral or lipid vectors) • Development of therapies that involve the delivery of cells (e.g., stem cell therapy)

Category	Subcategory	Description
Therapeutic Intervention	Medical Device	Development of: <ul style="list-style-type: none"> • Implantable devices • Mobility aids • Dressings • Medical equipment (other than that used for diagnosis) and prostheses • Approaches for the sterilization and decontamination of equipment or surfaces
	Surgery	The development of surgical, obstetric and dental interventions including: <ul style="list-style-type: none"> • Histocompatibility • Transfusions • Transplantations (including bone marrow) • Xenograft studies
	Radiotherapy	<ul style="list-style-type: none"> • Radiotherapy • Radioimmunotherapy • Radiosensitizers • Microwaves • Ultrasound (as a therapeutic) • Laser and phototherapy
	Psychological/ Behavioural	<ul style="list-style-type: none"> • Psychiatric treatment • Cognitive behavioural therapy and mindfulness-based cognitive therapy • Electroconvulsive therapy • Counselling
	Physical	<ul style="list-style-type: none"> • Physiotherapy • Occupational therapy • Speech therapy • Dietetics • Exercise • Osteopathy
	Complementary	<ul style="list-style-type: none"> • Hypnotherapy • Meditation • Massage • Acupuncture • Homeopathy
Preventive Intervention	Behavioural Risk Modification	Approaches aimed at preventing disease or promoting good health that largely focus on modification of people's behaviour (e.g., formulating content for sex education programs in schools; programs to encourage increased exercise). The reported approaches or products should have the potential to enter wide-scale use, not solely research to better understand behaviour.

Category	Subcategory	Description
Preventive Intervention	Physical/Biological Risk Modification	Approaches aimed at preventing disease or promoting good health which largely focus on approaches other than modification of behavior or nutrition/chemoprevention (e.g., male circumcision for prevention/reduction of HIV infection)
	Nutrition & Chemoprevention	<ul style="list-style-type: none"> • Prophylactic drugs • Food supplements (e.g., vitamins)
Management of Diseases & Conditions	N/A	<p>Development of approaches that address individual care needs and the management of disease, conditions or ill health that use existing products/interventions, including approaches focused on:</p> <ul style="list-style-type: none"> • Individual care needs (e.g., literature to promote self-care or improve health care by care providers) • End-of-life care (e.g., palliative care services)
Health & Social Care Services	N/A	Development of approaches focused on the provision and delivery of health and social care services, health policy and studies of research design, measurements and methodologies (e.g., (development of clinical care pathways)
Support Tool	For Fundamental Research	Development of products that are focused on underpinning research (e.g., new electron microscope detectors; software to analyze/display chemical structures, etc.)
	For Medical Intervention	Development of other products that are focused on medical interventions rather than a new/improved diagnostic or medical device itself (e.g., a new animal model to be used in drug testing; a new software tool for use in medical device design)
Products with Applications Outside of Medicine	N/A	Any products that have potential applications outside of medicine, where this is the primary focus of their application

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ALBERTA INNOVATES - HEALTH SOLUTIONS

Suite 1500, 10104 - 103 Avenue
Edmonton, Alberta
T5J 4A7

Phone: (780) 423-5727
Toll-free: 1-877-423-5727
Fax: (780) 429-3509
E-mail: health@aihealthsolutions.ca

aihealthsolutions.ca