Discussion Paper – Interdisciplinary Research Team Training

Title: Alberta's new health research paradigms: Are graduate students being prepared for interdisciplinary team research?

Background: Increasingly, stakeholders (including government) and funders are supporting large and complex health research projects that require the integration of differing knowledge bases and methodologies. Such integration is likely to occur in the form of interdisciplinary research teams. It is unclear whether universities and provincial organizations are able to respond to the changing health research paradigm by providing research training that enables graduates to participate effectively on these interdisciplinary research teams.

Purpose of the Discussion Paper:

- To inform stakeholders of the key issues associated with interdisciplinary research training
- To begin a consultation process with stakeholders designed to improve and expand training opportunities to produce health researchers who can work effectively in interdisciplinary research teams.

Recommended Action: To note the Discussion Paper and begin a consultation process

Key Background Information: Discussion Paper - Interdisciplinary research team training: Preparing graduate students for the next wave in health care research (see Discussion Paper).

Discussion Paper Prepared By: Students and faculty members of the course, Building foundations: An introduction to transdisciplinary research (University of Alberta INTD600)

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EXECUTIVE SUMMARY

Background

Relationships among research intensive universities and their public and private stakeholders, including government, funding agencies, industry, and health policy decision-makers are changing. Under a global umbrella of increasing demands for fiscal accountability, shifts are occurring in the strategic prioritization of research agendas, as well as roles and responsibilities in assuring that research goals are achieved. While there continues to be a demand for independent scientists seeking knowledge for knowledge's sake, an emerging solution-driven model is gaining momentum in health research. This emerging model has the potential to address problems with a large social and economic burden for society. Such problems are complex, and many can be addressed only though large interdisciplinary, inter-institutional, and multinational research projects. Universities have addressed the need for interdisciplinary research in their strategic planning documents. However, research training to equip graduates for careers in interdisciplinary research teams has not kept pace. The **purpose** of this Discussion Paper is two-fold:

- To inform stakeholders of the key issues associated with interdisciplinary research training, and
- To stimulate a consultation process with stakeholders designed to improve and expand training opportunities to produce health researchers who can work effectively in interdisciplinary research teams.

Potential **stakeholders** for a consultation process include Deans and Heads from Alberta research intensive universities; Alberta Innovates – Health Solutions and other funders; Alberta Health Services; other Alberta ministries with an interest in health research; members of interdisciplinary research teams; graduate students; end users of health research information; and others.

Implications

All areas of health research are being called upon to demonstrate a return on the financial investment. The traditional products of research – an academic paper or conference presentation - are no longer sufficient returns. Health researchers are being held more accountable for the extent to which they contribute to the health of individuals and populations, and the quality of the health system as a whole. As a result, researchers need to develop a clear vision of how their research contributes to these ends, and need to be able to show that such ends are being achieved. Demonstrating the knowledge and context of one's research will be insufficient. Funding agencies, particularly those managing public money, are under pressure from government to fund projects that tackle specific health care problems in Canada. To provide the largest return on investment, the research must not only reflect an understanding of its own context and relevance, it must make progress on a particular problem of importance. Frequently, these complex problems of common interest can only be addressed by researchers in multiple disciplines. This trend towards applied research with demonstrated returns on investment will require teams that are interdisciplinary, contextually relevant, and capable of working across health sectors. Certainly, research within disciplines will continue to be of value, but a significant portion of health research will have to be interdisciplinary to achieve this goal. While significant progress has been made in the realm of interdisciplinary research, the research environment continues to evolve, placing novel demands on health researchers. Now more than ever there is a need for universities and all partners to reflect on this change and ensure that trainees are appropriately prepared to work in this new and emerging research environment.

Recommended Discussion Points

Graduate students, universities, faculties and departments, Alberta Health Services, and Alberta Innovates-Health Solutions need to be involved in discussions about strategies to build capacity for interdisciplinary team research.

Graduate students

- select two supervisors or members of the supervisory committee from different disciplines;
- select a supervisor who works on an interdisciplinary team;
- be proactive in seeking courses, supervisors or situations that include a team atmosphere.

Universities, faculties and departments

- consider a 'boot camp' for all new health science graduate students to inform them broadly about the Alberta health research paradigm, four CIHR themes, clinical and policy implications of research, and how research knowledge is disseminated;
- consider developing credit courses that focus on actively building research team skills.;
- provide incentives and supportive environments that encourage faculty members to participate in interdisciplinary team research.

Alberta Health Services

- should act as a research broker to identify complex health problems and support interdisciplinary research through government-university partnerships;
- provide facilitated access to patients, health systems, and professionals to enable timely delivery of research results;
- continue to fund interdisciplinary team research.

Alberta Innovates- Health Solutions

- should adopt a leadership role in the support and coordination of graduate student training for interdisciplinary team research;
- provide flexible, student-centered funding arrangements, and support for students working in a range of environments.;

- facilitate targeted educational and networking events for AI-HS-funded students.

In summary, stakeholders should be informed of the key issues associated with interdisciplinary research training, and should stimulate a consultation process with other stakeholders to improve and expand training opportunities to produce health researchers who can work effectively in interdisciplinary research teams.

DISCUSSION PAPER – INTERDISCIPLINARY RESEARCH TEAM TRAINING

Introduction

Relationships among research intensive universities and their public and private stakeholders, including government, funding agencies, industry, and health policy decision-makers are changing [1, 2]. Under a global umbrella of increasing demands for fiscal accountability, shifts are occurring in the strategic prioritization of research agendas, as well as roles and responsibilities in assuring that research goals are achieved. While there continues to be a demand for independent scientists seeking knowledge for knowledge's sake, an emerging solution-driven model is gaining momentum in health research. This emerging model has the potential to address problems with a large social and economic burden for society. Such problems are complex, and many can be addressed only through large interdisciplinary, inter-institutional, and multinational research projects [1]. Universities have addressed the need for interdisciplinary research in their strategic planning documents [3-5], however, research training to equip graduates for careers in interdisciplinary research teams has not kept pace. With an Alberta focus, the purpose of this paper is to examine the forces changing the ways health research is, and will be, performed, and to describe the skills and experiences that health researchers will need to work within the new health research model. Additionally, we describe current training programs from the perspective of the four research themes of the Canadian Institutes of Health Research (CIHR; the major federal funder of health research). Finally, we offer recommendations to improve and expand training opportunities to produce health researchers who can work effectively in the interdisciplinary teams that solution-based research requires.

Alberta's health care system and the government-supported foundations that fund health research are changing rapidly. These changes impact the three research-intensive provincial universities, University of Alberta (Edmonton), University of Calgary and University of Lethbridge, which perform the vast majority of health research and train many of Alberta's future health

researchers. The first four authors are currently engaged in health research training at the University of Alberta and University of Calgary. They represent the four CIHR research themes (CIHR, 2009) and four different disciplines (bioethics, immunology, epidemiology, and medicine). The last two authors are faculty members in two different health science faculties and are research members of an interdisciplinary, inter-institutional, and multinational team. This paper is derived from their joint term project in the course, *Building foundations: An introduction to transdisciplinary research* (University of Alberta INTD 600).

Health research funding within Alberta accounts for a significant proportion of research expenditure. In 2007/2008, $335 million dollars were invested in the form of health research grants, trainee and investigator salary awards, and contracts [6]. The majority of this funding was from CIHR and the Alberta Heritage Foundation for Medical Research (AHFMR). AHFMR was formed in 1979 with the mandate to attract outstanding scientists to Alberta and to enable training and careers in health research [6]. Using a peer-review model, AHFMR has annual competitions for salary awards for faculty and trainees, establishment and, since 2008, large interdisciplinary team grants [7].

In Alberta, two major changes are occurring that will significantly alter the health research landscape. First, on January 1, 2010, AHFMR was disbanded and reformed as Alberta Innovates-Health Solutions [8]. The Government of Alberta's Ministry of Advanced Education and Technology, which is responsible for funding AHFMR, initiated this reorganization. Including the formation of AI-HS, the province is reorganizing its entire research infrastructure to align its priorities with other provincial research initiatives under the umbrella of Alberta's Research and Innovation System. The purposes of this reorganization are to (a) build partnerships, (b) align agendas, (c) build on current strengths, and (d) achieve outcomes with the most benefit for the health care system while achieving economies of scale and purpose [9]. As a result, government will be more involved with the strategic prioritization of health research questions and the formation of an AI-HS

research agenda that will likely focus on large complex issues in health most pertinent to Albertans. The new AI-HS will continue to give funding to trainees and new investigators by keeping the AHFMR endowment, which fuels its research agenda [6], while the responsibilities for funding senior investigators will transfer to the universities, thereby allowing AI-HS to fund more team-based research addressing societal priorities.

The second major change, initiated in April 2008, is the amalgamation of the province's nine regional health authorities, the Alberta Cancer Board, the Alberta Mental Health Board, and the Alberta Alcohol and Drug Abuse Commission into one entity: Alberta Health Services (AHS; [6]). Although neither the provincial legislation governing AHS (Regional Health Authorities Act, R.S.A. 2000, c.R-10, s.5) nor the Ministerial Order of November 19, 2008 to create AHS [10] contain an explicit mandate to conduct research, the Act does state that AHS is responsible for working toward the prevention of disease and injury, as well as assessing the health needs of the province. While both of these responsibilities could be fulfilled without conducting academic research, participation in research has been identified by AHS as a critical strategic priority to improve the health of Albertans [11].

In its strategic research plan, AHS outlines key health research actions. One of these is to develop and direct funding into pan-Albertan research programs. In Alberta, historically, large-scale provincial research partnerships have been hampered by competition, inconsistent goals, and administrative hurdles between the universities and health regions [11]. With new pan-Alberta priorities, there is a potential to improve cooperation in Alberta to optimize resources across institutions and jurisdictions. One of the AHS objectives, just as with AI-HS, is to be involved in research with the greatest potential for benefit to health service delivery and health outcomes, or solution-based research. The first priority will be clinical care (CIHR Theme 2), followed by health outcomes and population health research questions (CIHR Themes 3 and 4; [12]). AHS will not engage in basic biomedical research (CIHR Theme 1; [6]). However, there are plans to leverage

significant provincial funding in order to invest in the infrastructure required to carry out health research that aligns with the priorities for research outlined by the government [11]. This leveraging will be necessary as AHS anticipates budget shortfalls this fiscal year and the next, each exceeding $1B. In spite of its very limited internal resources to support research, AHS will have considerable influence over the health research agenda.

With the concurrent reorganization of AI-HS and AHS, it is apparent that a new model for driving and funding health research is emerging in Alberta. This model will include the universities, engage industrial and community partners, and is likely to affect the smaller research organizations in the province that have an arms-length relationship with government such as Alberta Genome and the Alberta Centre for Child, Family and Community Research. Its form and function is far from determined, although certain characteristics will likely develop. First, there will be an increased focus on strategic alignment of research interests, questions and resources. Partnering and leveraging of research dollars will be encouraged. A similar model for extending provincial base-support resources is described in the new strategic plan for the British Columbia Michael Smith Foundation for Health Research (MSFHR)[13]. By investing in research alliances, MSFHR will be able to focus funding towards areas of research deemed a priority for the province of British Columbia.

Second, as suggested by Tyrrell and Palmer [6] in their report to AHS on research, health research corridors will evolve in Alberta. These will capture major pan-Alberta research and care themes that cross university and organizational boundaries, similar to the Cancer Corridor, guided by the Alberta Cancer Board. Each corridor will include health care and research objectives will be organized to integrate the two. Other likely corridors will be in mental health, diabetes and metabolic diseases, cardiovascular diseases, and women's and children's health [6].

Finally, there will be an increasing focus on clinical, health outcomes, health services, and population health research. Total cumulative research funding for these areas is still a distant second to basic biomedical research funding in the province [6]. At the provincial level, the shift in

strategic research priorities and funding away from basic biomedical research may result in a conflict of scientific cultures unless the potential clash is recognized and addressed through greater integration of basic science with other areas of research. The other challenge emerging from this re-ordered set of priorities stems from the lack of capacity in the province to address large complex health problems that require large interdisciplinary and inter-institutional research teams. For many years, inadequate funding, too few mentors, and traditional performance evaluation structures at universities have slowed the development of investigators in interdisciplinary research; formal research training is almost non-existent.

In the emerging model, government and its programs, AI-HS and AHS, will drive research agendas and methodology. To achieve government goals, interdisciplinary team-based research will be an important vehicle (D. Fitzpatrick, personal communication, November 16, 2009). Universities will continue to receive the bulk of research funding, broker most of the significant partnerships, and house the majority of research. However, universities will also need to be full partners in these changes and become more proactive in helping to direct the change [1]. To date, there have been no position statements from Alberta's universities about how they will respond and become involved in these decisions and the changes that follow. The Tyrrell and Palmer [6] report suggests that new structures, called Integrated Academic Health Sciences Centres, will develop to bring together researchers, practitioners, and stakeholders from a variety of disciplines who share an interest in important questions in health. These Centres will involve universities, but in new and unfamiliar partnerships with AHS, AI-HS, government, and other universities. Universities must become much more engaged with the changes to the health research field to articulate their unique and essential roles in the new environment. In particular, universities have an essential role to play in health research training opportunities to ensure that students develop the basic competencies in interdisciplinary research that will be required to address complex health research problems identified by community stakeholders. It is necessary, then, to examine whether (a) the increased

need to train graduate students to work in the new integrated environment is being addressed, (b) current research training programs are capable of producing the numbers of graduates required for research in CIHR Themes 2, 3 and 4, and (c) the graduates of existing training programs are well-suited to work in such an integrated, interdisciplinary, and intersectoral research environment.

The Gap in Research Team Training for the Emerging Alberta Environment

There is no discussion of strategies to train researchers to operate successfully in the new integrated environment in any of the major documents underlying the creation of this new research model [8, 9, 14]. Similarly, none of the web-based documents from AHS or the Ministry of Alberta Health and Wellness detailing their priorities, including their research goals, address the need to train new researchers to work within their system [11]. Tyrrell and Palmer [6] did not mention graduate training in their report, particularly with regard to working within health corridors or integrated academic health science centres. Finally, no position papers have emerged from Alberta's universities about how they will prepare researchers to work in the new environment of integrated academic health science centres. Since the imperative is present, and rapid changes will be implemented in the next 12 months in Alberta, we believe that it is necessary and timely to examine current graduate student training practices in each of the four CIHR themes, identify gaps or deficiencies where appropriate in relation to interdisciplinary team training, and offer our suggestions for training graduate students to be effective interdisciplinary team members.

Defining Discipline and Interdisciplinary

A discussion of interdisciplinary research training raises questions about the definition of 'discipline'. It is difficult to provide a clear definition of the term that stands up to scrutiny. Expanding fields of study, shared technologies, and overlapping paradigms within research areas make it increasingly difficult to draw distinct disciplinary boundaries. In spite of this difficulty, several definitions have been offered. Bass [15] defines discipline as, "a domain of knowledge, an intellectual heritage with ancient roots, with language and methods for analysis and understanding

of aspects of the worlds that we inhabit and experience" (p. 102). Donaldson and Crowley [16] describe a discipline as, "a unique perspective, a distinct way of viewing all phenomena, which ultimately defines the limits and nature of its inquiry" (p. 10). While definitions of discipline vary in depth and scope, they share some points of agreement. A discipline is an area of study that has a distinct domain of knowledge, a shared language and understanding of the domain, refined methodologies, and a shared viewpoint or paradigm [15-18]. For an area of study to be a discipline it must also have researchers and practitioners working in that area [19], a literature and distinct curricula, professional societies, and journals [16, 20]. Most importantly, perhaps, the area must be recognized by others to be unique and distinct from other disciplines [16, 19]. In this discussion paper the term 'discipline' refers to an area of study with a distinct domain of knowledge, language, and methods that is broadly recognized by other disciplines and reflected in the structures of academic departments, academic journals, or professional associations.

Frequently, the terms 'interdisciplinary' and 'multi-disciplinary' are used interchangeably [21] to express a concept that is best synthesized by Karl Popper [22]: "We are not students of some subject matter, but students of problems. And problems may cut right across the borders of any subject matter or discipline" [22](p. 88). The term multidisciplinary describes an interaction where each discipline brings a clearly delineated, separate contribution to the whole, whereas the term interdisciplinary refers to an approach where integration and synthesis are keys to practice [23-25]. Interdisciplinary research is, "a mode of research by teams or individuals that integrates information, data, techniques, tools, perspectives, concepts, and/or theories from two or more disciplines or bodies of specialized knowledge to advance fundamental understanding or to solve problems whose solutions are beyond the scope of a single discipline or field of research practice" [23]. Interdisciplinary research is a response to changing research expectations that blur disciplinary boundaries and require greater integration of knowledge to solve large, complex problems [21]. While the importance of this kind of research is clear, and there is some consensus on its meaning,

the challenge of how to prepare the next generation of researchers to conduct excellent interdisciplinary research remains.

Traditional Health Research Training Paths

Generally, students working towards careers in health research receive training in thesis-based Masters and PhD programs. The number and type of required courses vary between and within academic institutions and departments, but it is typical that each graduate student has a primary supervisor and a supervisory committee to advise on his or her graduate training choices and to serve as examiners at various stages in their training programs. The student is expected to develop a research project that can be completed without the need for significant collaboration (the support of his or her committee notwithstanding). While some students can obtain experiential learning through research assistantships and self-secured work experience, typically there is no formal requirement for students in the fields of biomedical science, clinical science, health services, and population health to obtain interdisciplinary research experience. Additionally, each field has a slightly different 'take' on interdisciplinary research, which further contributes to challenges to research training. A brief description of health research in each CIHR theme follows.

Biomedical Research

Biomedical research serves to understand normal and abnormal human functioning at the molecular, cellular, organ, and system levels [26]. The goal is to develop a basic understanding of health and to use this knowledge to prevent, diminish or eradicate disease. The work of biomedical researchers also includes the development of specialized tools to assist them in their pursuit of knowledge, including pharmaceuticals and instruments intended for use in treatment up to the point where they are tested on human subjects. The boundaries between biomedical disciplines are roughly determined by the system level under study (e.g., cellular or organ level), the fundamental approach used to examine research questions (e.g., genetic or biochemical approaches), and whether the research is examining physiological processes or exploring ways to alter these

processes (i.e., pharmacology). These boundaries can be obscured because there are many methodologies and theories that are shared across multiple disciplines.

The degree of exposure to other basic science disciplines, clinical, health services, and population health research that a biomedical research student experiences depends on a number of factors. These include the nature of the research question the student is studying, the supervisor's attitude, and the research group or the department in which the training is occurring. For instance, basic biomedical research trainees within clinical departments such as Obstetrics and Gynecology or Surgery will have more exposure to clinical research and be more likely to collaborate with clinical investigators than trainees in a purely basic science department (i.e., Cell Biology or Biochemistry). It is extremely rare for a biomedical research trainee to collaborate with an investigator in health services or population health research.

Clinical Research

Clinical research is, "research with the goal of improving the diagnosis, and treatment (including rehabilitation and palliation), of disease and injury; improving the health and quality of life of individuals as they pass through normal life stages. It is research on, or for the treatment of patients" [26]. Clinical research occurs in all health science disciplines including nursing, rehabilitation medicine, and pharmacy, in addition to medicine. Frequently clinical investigations address systems, such as the pulmonary system, thereby leading to sub-specialization within larger fields. Clinical research has a defined set of methodologies and prescribed approaches to its unique questions, which are pervasive across clinical disciplines (e.g., pertain to both nursing and medicine). Individuals attracted to clinical investigation may be non-clinicians or they may hold a license to practice. A number of programs have been developed to attract practicing clinicians into research careers, including combined MD/PhD programs, MSc degrees in health science faculties, and PhD programs leading to faculty positions with substantial time allotted for research. In medicine, sub-specialty fellowship programs offer research training components to graduates

before they seek faculty appointments, while in nursing post-doctoral research, some fellowships can be taken up after graduates have secured a faculty appointment. Since research within a clinical discipline is not bound by a single CIHR theme, clinicians will study questions or use methodologies derived from any of the four CIHR themes. Hence not all clinician researchers perform clinical research as defined by the CIHR theme. As a group, therefore, clinician researchers are more interdisciplinary than their biomedical colleagues, although researchers in clinical investigation may or may not collaborate outside their theme and discipline.

Health Services Research

Health Services Research (HSR) is "research with the goal of improving the efficiency and effectiveness of health professionals and the health care system, through changes to practice and policy" [26]. HSR has emerged over the last 30 to 40 years as a distinct area of health-related research. Although the field's focus has changed over time, work in this area is typically defined by its intent to create knowledge to improve the operation and outcomes of health services. Typical HSR measures health outcomes, studies allocation of health care resources, evaluates health markets and health organizations, compares and analyses health systems, considers health economics, or measures the impact of health policies and regulations.

In addition to capturing a range of disciplines within its purview, health services research is often said to be multidisciplinary [27], as well as interdisciplinary. It is estimated that 50% of health services research is conducted in interdisciplinary teams. A quick scan of a recent health services journal (BMC Health Services, 2009) shows that roughly 80 per cent of the papers in the volume were produced by interdisciplinary teams composed of members representing an aggregate total of 34 disciplines.

Graduate student training for careers in HSR is varied. Within western Canada there are no graduate programs in HSR *per se*. Instead, more generalized programs support training in HSR among other types of health-related research. At the University of Alberta, for example, students

preparing for careers in HSR tend to receive their graduate training in the School of Public Health or the Faculty of Nursing. These faculties carry a broad curriculum and support students doing health-related research in a number of disciplines including health promotion, epidemiology, health policy and management, and biostatistics. Students in HSR are characterized by their choice of research project and faculty support rather than their participation in an HSR-specific curriculum. In spite of this dominance of interdisciplinary team based research within the field of HSR and the multidisciplinary nature of education for HSR trainees, there is very little formal training to prepare students to work in interdisciplinary research teams.

Social, Cultural, Environmental, and Population Health

The goal of social, cultural, environmental, and population health research is to improve the health of the Canadian population, or defined subpopulations, through a better understanding of how social, cultural, environmental, occupational and economic factors determine health status [26]. The CIHR Institute of Population and Public Health has expanded this definition to emphasize the intention to reduce the risk to populations and communities by focusing on community and/or societal-level factors which account for the distribution of risk in a society; rather than focusing on *individuals* most at risk, population health interventions implement policies and programs intended to protect, promote and improve the health of *populations* [28]. This elaboration on the CIHR definition emphasizes that public and population health research is moving beyond purely descriptive and analytical research and towards the implementation and evaluation of interventions to reduce health problems and inequities [29]. As Hawe and Potvin [29] point out, this shift requires an appreciation of the best that has been learned from the work of health and social scientists, suggesting that research in the area of public and population health, already interdisciplinary in its nature, will become more interdisciplinary in order to best answer the questions that need to be answered.

Current State of Interdisciplinary Graduate Research Team Training in Alberta

To date, no undergraduate or graduate level educational programs in interdisciplinary team research have been identified in Alberta. However, the University of Alberta and University of Calgary offer interdisciplinary graduate degrees in which student's research interest crosses at least two disciplines. The University of Alberta also offers the graduate level course, INTD 600, *Building foundations: An introduction to transdisciplinary research*. In this course, students learn where their research fits into a broader perspective of health and health research, and engage in readings, discussions and projects that build interdisciplinary team research knowledge and skills. The course is open to students from all western Canadian universities through the Western Deans' Agreement. Outside these opportunities, the onus is largely on the student to take the initiative to take advantage of interdisciplinary research opportunities as they arise. Most of these opportunities lie outside the formal academic program settings. Many research teams offer studentship or paid research assistant positions where students and trainees interested can gain valuable 'hands-on' research experience.

Recommendations

There is a clear need to increase the number of researchers in Alberta who are prepared to work in an interdisciplinary team environment. At present neither the universities, AHS, nor AI-HS have paid enough attention to building this needed capacity. Therefore we, as participants in the course INTD600, offer several recommendations to assist students, faculty, universities and provincial organizations to develop these researchers. To develop these recommendations, we read relevant literature, interviewed key Alberta academic leaders, provincial research leaders, and senior AHS officials, and conferred amongst ourselves.

Students

To be an effective interdisciplinary research team member, each graduate student (or investigator) on the team must be very well grounded in his or her own discipline. Each investigator must be an expert in a field of research necessary to the successful outcome of the team.

Students who want interdisciplinary team research experience or training need to be proactive by (a) seeking two supervisors from different disciplines or having an interdisciplinary supervisory committee; (b) seeking out supervisors who are on interdisciplinary teams whose agenda includes the student's research; and (c) presenting their work at interdisciplinary workshops or research conferences. Where formal courses or other training opportunities exist, students should enroll.

With the relatively low number of interdisciplinary research teams working in the province there may be insufficient spaces and mentoring relationships available for all students pursuing interdisciplinary team-based research training. Students who are unable to find opportunities to work directly with researchers on interdisciplinary teams can still prepare for research in an interdisciplinary environment by taking courses, participating in academic events, and developing relationships with graduate students in other disciplines.

Universities, Faculties, and Departments

Universities need to become more engaged in the setting of the new health research agendas because (a) they train and employ most of the researchers who will work in the new environment; (b) they are the sites where most of the research will be performed; (c) they will be hosts of the health corridors; and (d) they are integral members of the integrated academic health science centres.

To ensure that graduate trainees understand the emerging research environment and master the fundamental skills required for the interdisciplinary team-based research they are likely to encounter, universities across Alberta need to work collaboratively. In this fashion they should coordinate a health science 'boot camp' for all new health science graduate students to inform them about (a) the overall health research paradigm in Alberta, (b) the four CIHR themes, (c) the broad implications of every research question, and (d) how research knowledge is disseminated. Further, the universities should initiate a series of required workshops for all Masters and PhD students that provide opportunities for students to experience interdisciplinary team-based work. Additions could be made to the curriculum that would expose students to a diversity of research areas, methods, and topics, from inside and outside their research theme, and provide a venue for faculty already working on interdisciplinary research teams to share their experiences and advice. New courses could focus on active skill building to encourage students to develop strategies and methods to engage in teamwork (e.g., team formation, fostering relationships, and conflict prevention, mediation and resolution).

An optional advanced course could also be offered for students specifically planning a career in interdisciplinary team-based research. This advanced training could include a practicum component; students with a research background would be encouraged to obtain more practical experience (e.g., in government or private sector), while those coming from a practice-oriented background would be placed in a research environment. The intent of the practicum would be to broaden trainees' horizons so that they develop a more sophisticated understanding of the nature of their research question, the relevance and implications of their research, and to foster relationships between trainees and practitioners from other sectors and disciplines. Such additions to the research training curriculum should be developed at the provincial level and standardized across the province.

Faculties and departments also need to take an active role in, at minimum, developing openness to interdisciplinary team based research among faculty. Students will have a better chance of meaningfully developing the skills and attitudes necessary for interdisciplinary team-based research in an environment that promotes a positive, rather than a dismissive, attitude to other disciplines, or to the very concept of interdisciplinarity. Ideally, faculties and departments will support professors to mentor students in interdisciplinary team research by better supporting the interdisciplinary researchers themselves, and acknowledging faculty contributions to interdisciplinary team-based projects.

Universities need to overhaul organizational structures, tenure requirements, and support and reward systems so as to determine the direction and format of research. Valuing and recognizing efforts spent contributing towards team projects will pay dividends and make such research more attractive to other researchers.

Alberta Health Services

AHS's mandate includes the responsibilities to promote and protect the health of the population in the province, work toward the prevention of disease and injury, and monitor the health needs of the province (Regional Health Authorities Act, R.S.A. 2000, c.R-10, s.5). These responsibilities could be met, in part, by actively supporting the management of academic research in the province. Specifically, AHS has great potential to play a significant role in facilitating health research in a way that supports interdisciplinary team-based research and training. First, as a research broker, AHS should support research identified by themselves and other stakeholders through government-university partnerships. Second, AHS should enable universities to carry out research that requires direct access to samples, patients, or health care systems and professionals. AHS should also continue to hold competitions for team-based grants, especially interdisciplinary research teams.

Alberta Innovates – Health Solutions

Provincial health research funders, and particularly AI-HS, have key roles to play at every level of academic training and research. Indeed, AI-HS (via AHFMR) was largely responsible for shifting the research landscape in Alberta towards interdisciplinary team-based approaches and are constantly considering how they might modify their funding practices to better support trainees and researchers to prepare for this new environment. A multifaceted approach to training graduate students for interdisciplinary team-based research will require a flexible funding arrangement that is student-centered, rather than researcher centered, and provides support for students working in a range of environments. While AI- HS/ AHFMR already directly supports trainees through their independent studentship award program and indirectly through their Interdisciplinary Team Grant program, they could further support student training for interdisciplinary team based research by providing resources for work placement experiences. A portion of funding available for student research should be earmarked for student projects that demonstrate a distinctly interdisciplinary element. AI-HS has also taken a more proactive role by providing targeted educational and networking events for their funded students and researchers. Such events may promote interdisciplinary approaches by exposing participants to other disciplines, current interdisciplinary team based research, and training in team-building strategies. Similarly, funding provided to researchers and academics should be modified to ensure that more consistent support is provided to interdisciplinary team based research, particularly projects that incorporate student participation and training.

Overall Coordination

The new need to prepare young researchers to work in a solutions-based interdisciplinary team-oriented research environment demands comprehensive system-wide coordination, funding, and incentives. The responsibility to respond to this need is shared between the provincial government, AHS, funders, and universities. However, if research training is to occur progressively,

systematically and in a balanced fashion across Alberta, one entity must coordinate or manage this change. Such a coordinator would need to have a system-wide perspective on health research, the funds available to support students in a variety of academic and research environments, and have the power to motivate various partners to implement the programs required. The most obvious candidate for this role is AI-HS. Its predecessor, AHFMR, has done more than any other organization to shift the paradigm within the province so that the current research environment significantly integrates researchers, policy makers, practitioners and other stakeholders around several key problems in health. The new AI-HS will travel even further down this path. It holds a pan-Alberta perspective, the experience, the financial resources required to provide incentives, and the mandate to coordinate provincial efforts to increase capacity and develop tomorrow's researchers to work in the interdisciplinary research team environment that it is creating.

Summary and Final Comments

All areas of health research are being called upon to demonstrate a return on the financial investment made into its research. The traditional products of research – an academic paper or conference presentation - are no longer sufficient returns. Health researchers are being held more accountable for the extent to which they contribute to the health of individuals and populations, and the quality of the health system as a whole. As a result, researchers need to develop a clear vision of how their research contributes to these ends, and need to be able to show that such ends are being achieved.

Demonstrating the knowledge and context of one's research will not be enough. Funding agencies, particularly those managing public money, are under pressure from government to fund projects that tackle specific health care problems in Canada. To provide the largest return on investment, the research must not only reflect an understanding of its own context and relevance, it must make progress on a particular problem of importance. Frequently, these complex problems of common interest cannot be addressed by researchers in a single discipline.

This trend towards applied research with demonstrated returns on investment will require teams that are interdisciplinary, contextually relevant, and capable of working across health sectors. Certainly, research within disciplines will continue to be of value, but a significant portion of health research will have to be interdisciplinary to achieve this goal.

This call from students for a training environment that better prepares them for research with other disciplines is not new. Benzies et al. [30] identified the need for training and infrastructure to support students and new researchers who take intersectoral and multidisciplinary approaches to health research. While significant progress has been made in the realm of interdisciplinary research since then, the research environment continues to evolve, placing novel demands on health researchers. Now more than ever there is a need for universities and all partners to reflect this change by ensuring that trainees are appropriately prepared to work in this new and emerging research environment.

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