Evaluating a research training program for rural physicians

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A thesis submitted to the School of Graduate Studies in partial fulfillment of

the requirements for the degree of

Master of Science in Medicine (Clinical Epidemiology)

Division of Community Health & Humanities, Faculty of Medicine

Memorial University of Newfoundland

February 2021

St. Johns Newfoundland and Labrador

Abstract:

This thesis explores the development of an evaluative framework for the research training program called 6for6 and assesses its short-term effectiveness in developing research competency and productivity among rural physicians. To establish the framework, a logic model and an evaluation matrix were developed to outline components of 6for6 that could be improved. The effectiveness of 6for6 was assessed using a repeated measures analysis, a generalized linear mixed model (GLMM), and the Cochran Q test. Results from the GLMM show that overall research competency scores were higher in the intervention group in comparison to the control group (mean and standard deviation: 65.7% ± 37.6% and 58.6% ± 14.4%, $p<0.05$). Similarly, higher productivity rates were observed in the intervention group (80.6 ± 207.6 per 100 person-years) in comparison to the controls (8.4 ± 19.9 per 100 person-years, $p<0.0005$). Programs like 6for6 can increase the amount of research conducted in rural healthcare and improve participants' research competency and productivity.

Acknowledgements

I would like to thank Dr. Shabnam Asghari for agreeing to supervise my project. I have learned so much from Dr. Asghari and would not have made this much progress without her wisdom. I would also like to thank Dr. Cheri Bethune, Dr. Wendy Graham, and Dr. Cathryn Button for agreeing to supervise me and helping me improve as a researcher and an evaluator.

The 6for6 research coordinator, Mr. Tom Heeley, was also with me throughout every step of my degree. I have been very privileged to work with Mr. Heeley and have grown as a writer and researcher with his guidance.

I would also like to thank Elnaz and Gelareh who have helped me become a better student, as well as Oliver for his guidance and technological support. Thank you to all members of the Primary Healthcare Research Unit for their guidance and assistance throughout my time as a student and research assistant.

I will not forget the wisdom and support given to me by my partner Susannah throughout this degree. I also relied on my family, friends, and Fraser for support and encouragement. Lastly, I would like to thank the community at St. Michael and All Angel's church for supporting me during my time at Memorial University.

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List of abbreviations

COP: Community of practice

GLMM: Generalized linear mixed model

RP: Rural physician

RTP: Research training program

SA: Social accountability

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Chapter 1: Introduction and overview

1.1 Problem statement

There is a shortage of research in rural healthcare around the world. A systematic search for rural healthcare publications in Medline revealed only 20, 913 publications in its database of over 16 million citations.[1] This shortage also exists in Canada, where rural healthcare scholars are underrepresented.[2-4] While rural clinicians often adapt urban research findings to their local practices, the transferability of urban healthcare research to rural contexts remains unknown.[2] Findings from urban research must be tested on rural Canadian communities to account for their cultural, socioeconomic, and geographical diversity as these factors affect healthcare outcomes.[1-3]

To account for the diversity of rural contexts, scholars suggest that research could be done by rural clinicians who understand the healthcare needs of these communities.[5-8] Rural physicians in particular have expressed interest in conducting research and have the potential to create useable findings for their local practices.[5-9] Rural physicians' motivation for pursuing research stems from several factors, including their desire to address recurring health concerns within their community, to contribute to the science of medicine, and to attend research training programs that offer relevant content to their practices.[10-12]

Rural healthcare research should be contextually relevant in order to create useable findings for rural physicians' practices.[13-17] There are many disparities between rural and urban living that are related to poorer healthcare outcomes in rural areas, such as limited healthcare services, lower levels of education, and lower socio-economic statuses.[15-17] There are also differences between rural communities themselves, such as indigenous communities in northern

remote areas, rural farmers living in the prairies, and coastal fishing communities, that contribute to the variance between rural populations. [18,19]

Due to these contextual factors, urban healthcare research is not always adaptable to rural settings. Rural healthcare research would benefit from the involvement of rural physicians who directly work with these communities and address research questions related to their practices.[8-10] In partnership with academic researchers interested in rural healthcare research, rural physicians could provide a perspective that accounts for these contextual factors and thus make research questions relevant to their local practices. Such questions may include addressing arsenic contamination in well-water among rural residents, establishing an antimicrobial stewardship program for smaller rural hospitals, and exploring efficient use of aeromedical evacuation programs in remote regions.[9] These questions are often not applicable to urban contexts and urban researchers may not prioritize these types of questions.

Although rural physicians have potential to conduct research, it is challenging to develop their research capabilities due to barriers such as professional and geographical isolation.[20-24] For rural physicians, participating in research development opportunities often demands significant amounts of travel, requiring a steep expense of time and money.[22,24] Furthermore, rural physicians are already overworked and may become burdened with the additional responsibilities associated with research training. In addition to these barriers, one study reported that rural physicians in New Brunswick felt burdened by the amount of commitment to their patients outside of working hours.[20] An additional survey distributed to rural health professionals found that organizational support, such as a lack of paid leave and coverage for travel expenses, as well as a lack of support from their managers, were barriers to their professional development.[22]

While some may suggest that the COVID-19 pandemic requires all physicians to pursue research training online and thus imposes these same disadvantages onto urban physicians, internet access is more reliable in urban areas[25] and urban physicians may have existing connections due to the availability of colleagues in the area.[20] Even if rural physicians were willing to participate in online research training, virtual learning can be adversely affected due to poor internet access in rural areas.[26] Since rural physicians are sometimes the sole healthcare providers in their communities, they are professionally and geographically isolated and have few colleagues who could cover their clinical responsibilities during research training sessions. While all physicians may have barriers related to time, rural physicians must account for these barriers unique to rural practice.[27]

Existing rural clinician scholars often face significant competition from their urban counterparts when applying for grant funding.[3] Given their proximity to universities, it is likely that urban clinician scholars have access to more resources than their rural colleagues, such as technological support teams, librarians, research mentors, and research training programs (RTPs).

In this thesis, an overview of existing RTPs and methods for building research capacity will be described. This thesis will also outline a trajectory through which rural physicians can acquire the tools necessary to become researchers by participating in a rurally focused RTP. Finally, the results of a quasi-experimental study will be reported, and the effectiveness of this RTP in building research competency and productivity among rural physicians will be discussed.

1.2 Research capacity building in rural healthcare

RTPs are essential in the development of research skills for rural physicians. RTPs offer beneficial resources such as experienced personnel (e.g., mentors, research assistants, technological support teams, librarians, and guest speakers), funding opportunities (e.g., operational funds and grant funding for travel and accommodations) and learning activities (e.g., workshops, lectures, and round table discussions).[28,29] Among these benefits, one study cited ongoing support as an important factor in research development among rural healthcare workers.[30] Rural physicians would benefit from ongoing support from research mentors, who could impart their understanding of the application processes for grants and ethics.[31] Mentors can also help limit the size of their research projects, planning project timelines, and selecting key stakeholders to involve in the planning process.[31]

While RTPs for rural healthcare clinicians are limited in number, many of these programs have published findings showcasing their effectiveness in developing researchers. For example, the researcher development program in Australia[32] conducted a survey of participants' research knowledge, attitudes, and practice, and found that participants had improved in all three categories.

Using a similar cross-sectional study, another Australian RTP observed an increase in research confidence among rural and remote healthcare workers. This study found that these participants were also able to submit one article to a peer reviewed journal and present their progress within two years.[33] This program is delivered in three different rural areas and is therefore an accessible program for many rural clinicians. One limitation, however, is establishing networking opportunities with rural clinicians between these three different areas.[33]

A third RTP in Australia conducted interviews to assess its impact on rural healthcare workers and the perception of research in the workplace.[30] The results revealed that the program was beneficial in terms of networking with other researchers and developing mentor relationships. These results also highlighted challenges in engaging rural healthcare workers in research. Through this series of interviews, some participants indicated that their managers were less interested in their research development and more concerned with how much time they spent away from work.[30] Overall, this study suggests that rural healthcare workers can benefit from RTPs when their managers are supportive of their research endeavours.

A clinical research support team at the Jichi Medical University in Japan has engaged in ongoing collaboration with rural physicians over email to disseminate research advice. Despite communicating at a distance, rural physicians who used this service were able to establish a mentor-mentee relationship.[34]

To address similar issues in Canada, the 6for6 RTP was established at Memorial University in 2014 as an accessible training program for rural physicians.[28,29] By participating in 6for6, rural physicians pursue their research interests by developing a research project related to their local practices with the help from their research mentors and the research coordinator. To develop their competency and productivity in research, 6for6 participants engage in a variety of interactive experiences such as round-table discussions, face-to-face workshops, lectures, group activities, and eLearning modules.

The importance of face-to-face interactions is reflected in the literature as a step toward building networks and establishing relationships in research.[35-38] To ensure this is a possibility, 6for6 sponsors the travel and accommodations for six rural physicians to travel to the St. John's campus at Memorial University for six weekends within one year. This time spent away from

their practices also provides rural physicians with the freedom necessary to work on their research projects. Furthermore, research development requires ongoing support from research colleagues, which 6for6 provides in the form of mentors, librarians, research assistants, and technological support personnel.[30] In the event that participants are unable to attend sessions, they have the option to learn remotely through online resources.

1.3 Thesis outline

To conceptualize this thesis, we conducted a literature search with a librarian at Memorial University of Newfoundland. Findings from this literature search constituted the foundation for this thesis and its theoretical framework. This information is provided under the following sections listed. Evidence about programs supporting rural health research is available under section 1.2. Literature related to the theoretical framework for developing a rural health research model is available under section 2.3.1. Previous works on the effectiveness of rural health research training programs is provided under section 3.3.

This thesis has four chapters. Chapter one outlines a problem statement for the thesis and provides an overview of research capacity building initiatives. The objective of chapter two is to build a logic model describing how rural physicians are able to obtain the tools necessary to become researchers. The third chapter, which was accepted for publication in the Canadian Journal of Rural Medicine, will focus on assessing the effectiveness of 6for6 in building research competency (knowledge, attitudes, and skills) and productivity among rural physicians (publications, grants, and presentations of research-related work at conferences). Chapter four will discuss how the findings of chapters two and three are related to one another and how they compare to the literature.

1.4 Research questions

1) What are the necessary components of a research training program that empower rural physicians to pursue research development? 2) What is the effectiveness of the 6for6 research training program in building research competency and productivity among rural physicians?

1.5 Theoretical frameworks

There are several theoretical frameworks related to the 6for6 program that also connect the four chapters of this thesis. Social accountability represents a requirement for medical schools to address the health concerns of their local communities. One aspect of social accountability suggests that members of these local communities should guide the research agendas. In underserved areas such as rural communities, physicians are at the front lines of their local practices and are mindful of which research questions should be addressed as well as potential solutions for them, making them well-positioned to pursue research. 6for6 trains rural physicians to address community health issues head-on by conducting community-based research projects.[39]

Communities of practice are "groups of people informally bound together by shared expertise and passion for a joint enterprise…" and represent one of the frameworks that guided this thesis. This framework represents how 6for6 participants improve their research capabilities through collaboration with their colleagues and 6for6 mentors. Through roundtable discussions, participants discuss their research projects, receive constructive feedback and hear new ideas to help them improve their research competency and productivity.[38]

Experiential learning, problem-based learning and the theory of mentorship were chosen as the three teaching and learning frameworks that relate to the chapters in this thesis and the 6for6 program. Experiential learning is a theory where an individual reflects on concrete

experience to conceptualize potential solutions and experiment with new ideas.[35] 6for6 embodies this approach by engaging participants in research projects relevant to their practices. For example, researchers who were rejected after applying for ethics approval would first reflect on this experience, conceptualize a new approach to their ethics application, and try again using a new approach. Problem-based theory is a sub-category of experiential learning where learners focus on real problems with ill-defined solutions.[36] Typically conducted with a group of eight to ten people guided by a mentor, learners make use of both individual and shared learning experiences to develop their reasoning skills. Learners often start by identifying their current knowledge of the subject and then use their reasoning skills to find the correct solution. This approach enables learners to take advantage of the many perspectives provided by group learning while also dedicating time to individual reflection. Both experiential and problem-based learning make use of experiences with concrete learning, which is how 6for6 participants develop their research capabilities. Through developing their own community-based research projects, participants can practice what they learn both on their own and through group-based discussions. To guide participants through these experiences, the 6for6 program relies on the theory of mentorship.[37] Mentors offer the participants a chance to receive personalized feedback and evaluation, as well as an opportunity to build strong connections with experienced researchers. Since these relationships help rural physicians overcome their professional isolation barriers, the theory of mentorship applies directly to 6for6 and this thesis.

1.6 Methodological and Statistical approaches

A modified version of the Delphi method was used to develop a logic model and an evaluation matrix in chapter two. The Delphi method is an iterative process through which participants submit their ideas to a moderator regarding a knowledge gap to reach a consensus as

a group. After each round of the activity, participants reflect on feedback provided by the moderator who aggregates these ideas and discusses them with the participants. After several rounds of the activity, participants usually come to a consensus regarding the topic.[40]

While the traditional Delphi method allows participants to submit their ideas anonymously, modified versions are useful when participants need to interact with each other and justify their ideas or explain their disagreements.[41] Although anonymity ensures that attempts to coerce participants into conforming with an idea is limited, some participants had varying levels of experience with the program and therefore discussion was an effective tool to resolve misunderstandings.

In chapter two, the researchers developed a logic model to visualize how rural physicians pursue research through the 6for6 program.[42] Program developers find logic models useful in order to understand how the inputs and activities help participants achieve their intended outputs, outcomes and goals. Logic models also ensure stakeholders have a common conceptual understanding of how the program is implemented, which facilitates communication with external stakeholders about the program. While linear logic models are often criticized for oversimplifying complex programs,[43] variations such as the nested model can be used to incorporate more than one perspective.[44] This nested model was chosen by the 6for6 team to develop two logic models, where one represented the program and administrative level and the other represented the participant level. Chapter two focuses on the latter perspective.

Generalized linear mixed models (GLMMs) are statistical models that account for random effects from several different factors. This study uses data collected over time that contains variability between participants, including the various disciplines of medicine practiced by the participants, the different resources available in their communities, and the number of

years spent in practice. Variability also exists among participants themselves, who take the same survey at different times during the study. Since the GLMM is appropriate to handle comparisons between rates and means, the researchers used this model in chapter three.[45]

The researchers were also interested in comparing the proportion of participants who were productive before, during and after the study in chapter three. The Cochran Q test is a non-parametric statistical test that compares paired data collected at three different times. Since the research question is related to how participants improve their productivity as a result of 6for6, the number of rural physicians producing research before, during and after the program in the form of publications, grants or presentations of research-related work at conferences would directly answer this research question.[46]

Repeated measurements were also used to compare the participants' mean research competency scores at zero months, during the program, and at twelve months. In order to detect changes across time in comparison to baseline competency, the researchers used a repeated-measures ANOVA for paired-data. This is an appropriate statistical test since the researchers collected research competency data from paired samples.[47]

1.7 Co-authorship statement and acknowledgements

In 2020, a version of Chapter three was accepted for publication by the Canadian Journal of Rural Medicine. All authors substantially contributed to the conception of this study. The thesis author developed the study design, conducted the literature search, collected, analyzed and interpreted the data, and provided an early draft of each chapter in this thesis. Dr. Shabnam Asghari played a key role in the delivery of the 6for6 program as well as the development of the study proposal, literature search, study design, data collection, data analysis, and manuscript development. Dr. Cheri Bethune and Dr. Wendy Graham played an important role in the delivery

of 6for6, literature search, data collection, development of the manuscripts, and expertise in research development strategies. Dr. Cathryn Button is an expert in program evaluation and contributed to the development of the 6for6 evaluation tools and the manuscripts. Mr. Thomas Heeley contributed significantly to the program delivery, literature search, manuscript development, and data collection. Further contribution details can be found in chapters two and three.

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Chapter 2: Rural physicians as researchers - defining a logical pathway for success

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2.1 Abstract

Problem being addressed: Rural physicians experience barriers to conducting research, such as professional and geographical isolation. Although certain research training programs for rural clinicians have been initiated to address this issue, there is no published framework outlining how to address the research training needs of rural physicians. Objective of program: To establish a framework articulating how rural physicians pursue research development through the 6for6 program. Program Description: Using a modified Delphi approach, we established a logic model to visualize the inputs, activities, outputs, and outcomes of 6for6, a research skills program for rural physicians at Memorial University. In the evaluation matrix, we developed evaluation themes, questions, data collection methods, responsibilities and timeframes to improve the aspects of 6for6 identified in the logic model. Conclusion: Establishing a framework to evaluate and improve research training programs is necessary to ensure they benefit rural physicians. This framework is useful for any institution interested in establishing a similar program elsewhere. To the best of our knowledge, 6for6 is the first program of its kind to establish essential program components for the research development of rural physicians.

2.2 Key points

- A framework portraying rural physicians' involvement in a research training program is essential for the development of similar programs at different institutions.
- A logic model is an effective tool for identifying key components of research training programs that may undergo improvement. Evaluation questions related to the logic model are developed to improve program components.
- The findings in this article may help program planners and rural physicians understand the importance of research training programs as professional development opportunities.

2.3 Problem being addressed

While research training programs (RTPs) have considerable potential as catalysts for grassroots healthcare solutions, these opportunities are scarce for Canadian rural physicians (RPs).[1-7] Most healthcare research is conducted through an urban lens[8,9] and the voice of RPs in scholarship has been further tempered by professional and geographical isolation.[1-7,10] Furthermore, barriers such as competitive funding opportunities and a lack of time and organisational support limit RPs' involvement in research.[11-13]

The limited number of rurally focused RTPs[14-19] who have addressed this issue have not described a process for addressing the research training needs for RPs. Moreover, existing frameworks describing the research development process for clinicians are often not transferable to rural contexts.[20-23] As such, there is a gap in understanding how the research skills of RPs can be enhanced to enable the discovery of locally relevant solutions to health care problems.

To address this gap, we conducted an evaluation of an RTP to improve the journey undertaken by RPs pursuing research development. This paper reports on an evaluative framework for an RTP for RPs using a logic model and an evaluation matrix.

2.3.1 Theoretical frameworks

We conducted a literature search identifying theoretical frameworks for research capacity building. These frameworks are associated with training programs, research development initiatives in health professions, and curriculum development publications. Using a framework created by Kern and colleagues,[24] we developed a curriculum for the 6for6 RTP. Details about 6for6 can be found in previous articles.[14,15] For capacity building in research, we identified two categories of frameworks: teaching and learning frameworks, and community-oriented frameworks.

The three teaching and learning frameworks selected were experiential learning, problem-based learning, and the theory of mentoring. Experiential learning involves participating in hands-on experiences followed by reflective observation.[25] This is a relatable framework for physicians, who trained in authentic clinical settings to learn and understand the complexities of medicine. Experiential learning is also problem-based learning,[26] where learners establish their knowledge base by engaging with real patients and real problems, often with ill-defined solutions. To supplement their individual progress, medical learners rely on preceptors for expert clinical coaching, empowerment, and guidance.[27]

The community of practice (COP) and social accountability (SA) frameworks constitute our two community-oriented frameworks. The COP framework was chosen to reflect the importance of networking and working and learning together with those who have mutual interests.[28] The benefits of a COP include learning from those who have more experience, or in teaching those with less experience along with the benefits of peer learning. The SA framework addresses the obligation of healthcare systems, organizations and medical schools to help the

communities they serve.[29] For physicians, this framework is paramount because the healthcare issues of their local communities are often what drives them to seek research training.

The frameworks we identified reflect the interactive and hands-on nature of 6for6 for RPs. 6for6 participants gain hands-on experience by developing their own research projects, which entails refining their research questions, conducting literature searches with librarians, investigating and choosing research methodologies appropriate to their questions, and completing ethics and grant applications. Furthermore, these participants engage in problem-based learning through interactive lectures, workshops, and roundtable discussions. 6for6 mentors are paired with participants based on mutual research interests to oversee the development of their research projects. In addition to their mentors, participants are also supported by a research assistant. 6for6 often resembles a COP, where participants regularly meet to learn, develop their projects, refine the projects of fellow participants, and discuss mutual research interests. This approach fosters both group accountability, through the expectation and encouragement for all participants to be successful, and social accountability, as projects address locally relevant rural health care challenges.

2.4 Objective of program

We put this framework into practice by creating an incisive logic model for our program. In this article, the logic model focuses on the participants and their journey to becoming researchers.

Our first step toward developing the logic model was identifying the short-, medium- and long-term objectives for 6for6 participants.

- Short term: To enhance research competency (knowledge, attitudes, and skills) and productivity (publications, grants, and presentations of research-related work at conferences) and improve knowledge exchange among RPs.
- Medium term: To strengthen the research community among RPs by facilitating participation in scholarly research.
- Long term: To recognize RPs as leaders in the research community, demonstrated through increased research in rural practice.

2.4.1 Logic model development

We began developing the logic model in partnership with three professional program evaluators and a professor with expertise in program evaluation. The research team included an RP, a faculty development expert, a research methodologist, a research assistant, and a graduate student. The logic model was developed using a modified Delphi approach over three rounds. Each round followed the same format and is described in the following three steps:

1. Each round began with a brainstorming session between members of the research team to draft the activities, inputs, outputs, and outcomes related to the research development of 6for6 participants.
2. The research team critiqued the draft until a final set of words were chosen to represent the logic model components. This draft was emailed to the program evaluators.
3. Feedback was passed on from the evaluators to the research team to clarify the causal relationships within the program and address disparities within the logical flow between components of the logic model. Iterative, participatory activities between the research team and program evaluators helped address disparities within the logical flow between

components of the model and establish appropriate categorization of the logic model components.

These steps were repeated until a final logic model was established. Each round consisted of eight participants and a consensus was reached after three rounds of the activity.

2.4.2 Evaluation matrix development

The same personnel that created the logic model also developed the evaluation matrix. Using an iterative, modified Delphi approach to discuss the most pertinent variables of 6for6, the evaluators, the research methodologist, the research assistant, and the graduate student drafted and refined evaluation questions. Each round was dedicated to drafting questions related to an evaluation theme suggested by the evaluators. After six rounds of this exercise, we reached a consensus on which questions would be included in the evaluation matrix. Using a similar process, the research team and program evaluators finalized the indicators and data collection methods, which are defined as the measurable data and resources that suggest answers for the evaluation questions. A draft of the evaluation matrix was sent to an RP, a faculty development expert, and a professor of program evaluation to review and approve.

2.5 Description of program

2.5.1 Logic model

Results from the consensus building exercise can be found in figure 2.1. The final product was organized into sub-categories that visually represent the causal mechanisms responsible for developing researchers among RPs. The model is navigated by moving between boxes from left to right, and top to bottom. The boxes are organized into the following rows: Inputs, activities, outputs, and outcomes (short-, medium- and long-term).

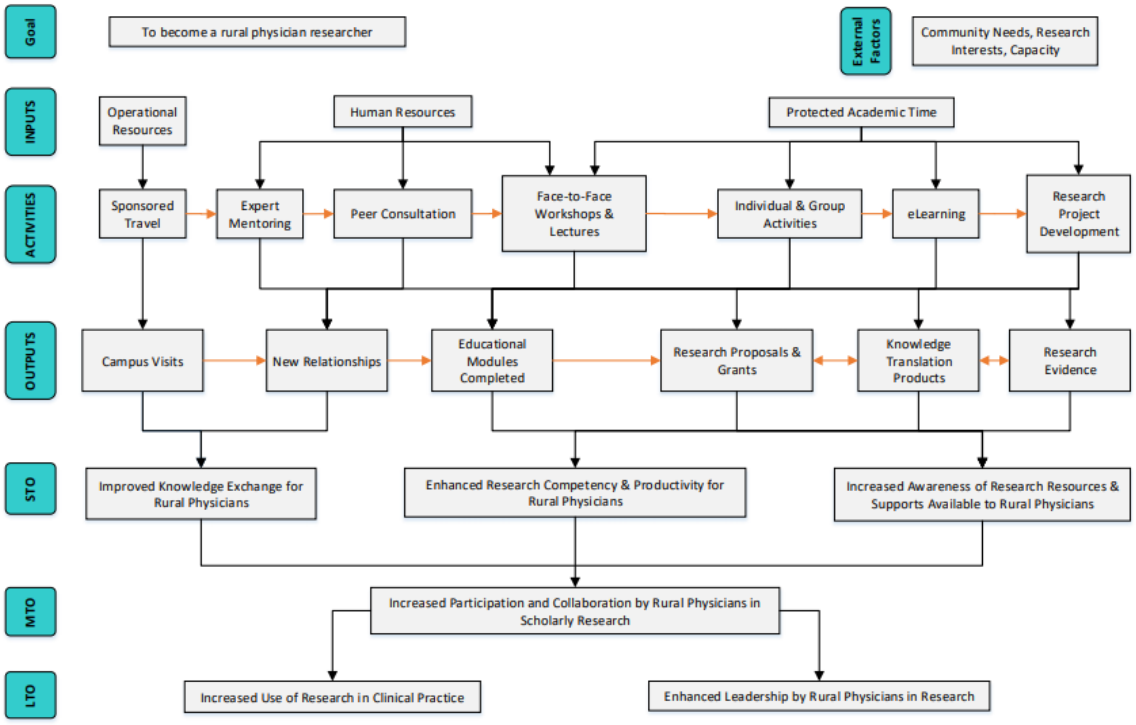

Figure 2.1: Logic model of the 6for6 research training program for rural physicians

As shown in the logic model, the goal for a 6for6 participant is "to become a rural physician researcher." There are three external factors that contribute to the development of 6for6 participants and their research projects: community needs, research interests, and capacity. To address the healthcare needs of their local practices, 6for6 requires that participants' research projects emerge from their perception of community needs. Participants are also encouraged to engage their curiosity in research and pursue projects they find intrinsically motivating. Finally, given that participants are relatively new to research and manage high clinical workloads, 6for6 mentors ensure that research projects are feasible, and can be completed.

The inputs include all resources necessary to develop the research capabilities of participants. The first is operational resources provided by the Faculty of Medicine, which includes financial support to sponsor travel expenses and accommodations for 6for6 mentors and

participants, and in-kind services from the Faculty of Medicine. The next category, human resources, represents anyone invested in 6for6 by the Faculty of Medicine. The research assistant dedicates time to program delivery, supports participants' research projects, and complements the mentors who work with participants one on one throughout the development of participants' research projects. The last category is protected academic time, where participants have dedicated time to spend on campus to work on various research tasks, such as manuscript writing, searching the literature, or seeking grant and ethics approval. This last input reflects experiential learning, where 6for6 participants benefit from hands-on experiences in the research world.

Next are seven activities that are integral in developing the research capabilities of 6for6 participants. The first activity, sponsored travel, is dedicated funding for participants' accommodations, travel, and meals. While 6for6 provides coverage for travel and accommodation fees, the program is not responsible for finding physicians to cover their practices or to supplement their income. Expert mentorship is provided by experienced researchers who work closely with participants and develop strong mentor-mentee relationships. Matchups are created by the first day of the program however they can change based on mentors' expertise related to participants' research projects. In any case, there are many opportunities for any mentor to interact with different participants. Peer consultation is executed through round table discussions where participants receive constructive criticism from their fellow peers and mentors in the program. Face-to-face workshops and lectures are conducted by 6for6 mentors and guest speakers on topics such as research methodology, scholarly writing, ethics approval, library services, knowledge dissemination, community engagement, and team management. Individual and group activities complement the interactive lectures and workshops, where

participants develop research questions, conduct literature searches, critique abstracts, or participate in writing exercises. eLearning consists of modules posted to an online portal that enables participants to work on program content at home. The content includes supplementary videos, readings, and archived materials presented in lectures and workshops. Through the culmination of the previous six activities, participants can develop their research projects, as a work in progress throughout the year. These activities reflect principles related to experiential and problem-based learning, creating an authentic research experience for participants that matters to them and their practice.

Together, these activities produce six outputs. First, six participants make six visits to the Memorial University campus per year. Next, new relationships and networks are formed on campus between fellow participants, mentors, librarians, computer support personnel, and research staff. The third output refers to the educational modules completed, including topics from introduction to scholarly writing and research to dissemination of completed research. After the completion of these modules, participants engage in writing research proposals in order to apply for ethics and grants. Participants' knowledge translation products become the fifth output, where they share project results through posters, presentations, conferences and publications. The final output is research evidence, which refers to the application of participants' community-based research to their local practices.

Characterized as milestones reached by participants during their journey to becoming researchers, we established short-, medium-, and long-term outcomes, signifying three levels of achievement in research. These outcomes are identified as STOs, MTOs, and LTOs in the logic model. Upon graduation from 6for6, we expect that participants will demonstrate improved knowledge exchange capabilities, enhanced research competency and productivity, and an

increased awareness of resources and supports available for RP researchers. Five years after graduation, we anticipate participants to become more involved in research, reaching the MTO. Within ten years of completing the program, we predict that more RPs will achieve the LTOs, which includes integrating research into their clinical practice and emerging as leaders in the research and teaching community.

2.5.2 Evaluation matrix

The evaluation matrix describes the following four themes of the evaluation process for 6for6: 1) relevance 2) design & delivery; 3) access & reach, and; 4) effectiveness & efficiency. Each theme has several questions we deemed feasible to answer based on available indicators and data sources. Relevance reflects our interest in exploring the novelty of 6for6 at the present time. Design & delivery refers to how 6for6 functions in practice, and whether this reflects the plan established by stakeholders. Access & reach describes the promotion strategy behind 6for6, and any barriers preventing potential stakeholders or participants from becoming involved in 6for6. Effectiveness & efficiency refers to how well 6for6 achieves its intended goals.

We established six methods to collect evaluation data: jurisdictional scans (e.g. number of article citations), document reviews (e.g. reviewing meeting minutes), key informant interviews (e.g. interview with an RP), focus groups with participants or stakeholders, research outputs (e.g. publications, grants, and presentations of research-related work at conferences), and pre-post surveys assessing participants' research competency and productivity. Columns describing the indicators, data sources, timelines, responsibilities for 6for6 personnel, and the use for evaluation findings were also included in the full evaluation matrix. A sample evaluation matrix can be found in Table 2.1, however the full matrix is provided in Appendix A.

The evaluation questions were chosen based on their potential to identify the context in which 6for6 operates. The realist evaluation approach suggests that evaluation findings are influenced by their context, which is comprised of the program's personnel, its participants, and environmental conditions such as organisational support.[30] Realist evaluations should be conducted in order to understand how and why new programs are working, and whether they would be effective in other contexts.[31] This approach is important for a new program like 6for6, which relies on many activities and resources to develop the research capabilities of RPs.[30-32] In order to capture both how and why 6for6 works, the research team is collecting both qualitative and quantitative data to analyze every possible mechanism that may contribute to enhanced research skills. Stakeholders were engaged in the evaluation process as early as possible to develop evaluation questions with a contextual focus.

Table 2.1: Sample evaluation matrix of the 6for6 research training program for rural physicians

Theme	Evaluation Question	Indicators	Data Collection Method	Timeline	Use of Findings	Logic Model Connections
Effectiveness & Efficiency	Has 6for6 contributed to an increase in scholarly activity among rural physicians?	• Research competency survey scores • # of conferences attended by participants • # of publications/grants by participants • # of research projects conceptualized • Research content in participants' CVs before/after 6for6 • Inclusion of 6for6 into academic curriculum of Memorial University • Mentors, staff and 6for6 participants' perspectives	• Pre-post surveys • Pre-post program needs assessment • Document review • Interviews • Focus group	2014-2019	To understand the relationship between 6for6 and scholarship in the medical communities where 6for6 has involvement.	STO: New evidence contributed to knowledge base MTO: 6for6 is a university course STO: Enhanced research knowledge and skills for rural physicians MTO: Increased participation and collaboration by rural physicians in scholarly research

2.6 Discussion

This paper outlines a framework to evaluate a research training program (RTP) for rural physicians (RPs), with a focus on their journey to becoming researchers. The 6for6 logic model shows different levels of research involvement that are possible for RPs. Additionally, the matrix identifies five themes through which the 6for6 program can improve its experience for RPs. As a result, 6for6 is a complex program that depends on a variety of resources and activities to develop the research capabilities of RPs. This implies that the process for becoming a researcher may differ for each participant. Some may become leaders in research, and others may participate in research projects. The end goal for each participant will depend on their background knowledge, their interest in research, and their capacity for learning and conducting research.

This evaluation was guided by several theories, most notably utilization-focused evaluation and the realist evaluation approach.[30,33] Utilization-focused evaluation can be described as focusing an evaluation on providing useful findings for intended users. Given that 6for6 is designed to overcome the barriers experienced by RPs in pursuing their research development, the evaluation was designed to reveal useful knowledge regarding how to improve 6for6 in the interest of its participants.[33] The realist evaluation approach encourages program evaluators to be mindful of the resources, personnel, and organisational support available for the program. In discovering what works for participants, and based on organisational support for rural healthcare research initiatives by Memorial University, we created the logic model and evaluation matrix to reflect the context in which 6for6 operates.[30] Another evaluation theory that guided this framework was the theory of change approach, which articulates the underlying assumptions within the logic model.[34] While the boxes in this logic model represent the

milestones reached by RPs undergoing research development, theories of change explain how the participants move between these milestones. For example, the logic model is an accurate representation of how an RP can pursue research provided that certain assumptions are met, such as RPs' interest in pursuing research, a willingness to travel to the university campus to attend sessions, and their ability to find colleagues to cover their clinical responsibilities during the sessions. Using these evaluation theories, we can understand both what works for participants, and under what circumstances.

This framework has some limitations. The framework we established may not be applicable to other institutions with different resources for RPs. Furthermore, RPs from different provinces may have different obligations that can impact their potential to participate in RTPs. Therefore, if other institutions use the 6for6 logic model to build their programs, their final product will likely differ from 6for6. Future research would benefit from assessing the feasibility of this logic model in other jurisdictions in order to determine how it fits within other contexts.

Another limitation includes the involvement of program evaluators from the same department, the Primary Healthcare Research Unit. While the 6for6 program was developed by members of this department, the program evaluators were never involved with developing the research capabilities of 6for6 participants. However, we would advise similar programs to make use of external evaluators to completely mitigate this bias.

The projected timelines for achieving the medium- and long-term objectives may vary between participants. For instance, before RP researchers have enough experience to conduct research projects independently, they may require more time and support to further develop their competency in research. Therefore, it is possible that measuring an increase or decrease in the integration of research in clinical practice and teaching will take longer than expected. For

similar programs, we recommend beginning data collection for program improvements as early as possible.

2.7 Conclusion

RPs have the potential to become more scholarly as clinicians. The availability of an RTP to enhance those capabilities is expedient. The recruitment and longevity of this program in a rural province is a testament to its value. Establishing a framework to evaluate and improve this RTP is necessary to ensure that program delivery is beneficial to the participants and the community. This framework can be useful for any institution interested in establishing a similar RTP for RPs. To our knowledge, this is the first framework articulating a pathway through which RPs can develop their research capabilities.

2.8 Contributions

All authors substantially contributed to the conception of this study. CM, SA, NP, SP and TH contributed to the study design. CM and SA analyzed the data. CM, SA and TH interpreted the data and provided an early draft of the manuscript. All authors provided critical review and feedback for the manuscript.

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Chapter 3: Assessing the effectiveness of a research training program in developing research competency and productivity among rural physicians

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3.1 Abstract

Objective: To assess the effect of a training program called 6for6 on research competency and productivity among rural physicians. Design: We conducted a quasi-experimental study, comparing research competency and productivity between intervention and non-equivalent control groups, and over time through a repeated measures design. Generalized linear mixed model (GLMM), ANOVA, and Cochran Q tests were conducted. Intervention: The intervention is 6for6, a year-long program in which six rural physicians develop research skills over six weekends. Physicians learn about various research methods and writing techniques through blended learning components. The intervention was provided to five groups of six rural physicians each between 2014 and 2019. Main outcome measures: Self-assessed research competency (knowledge, attitudes, and skills) and productivity (publications, grants, and presentations of research-related work at conferences) were our primary and secondary outcomes respectively. We measured these outcomes before, during and after the program. Control: Rural physicians who expressed interest in 6for6 and later enrolled in the program. Results: During the study period, 30 participants graduated from the program. This study shows that overall research competency was significantly different between intervention and control groups (65.7% ± 37.6% and 58.6% ± 14.4%, $p<0.05$ for GLMM). The percentage of participants who were productive before, during, and after 6for6 was 26.7%, 16.7%, and 50.0% respectively. Overall, productivity rates were significantly different between intervention and control groups (rate difference was 72.2 per 100 person-years, $p<0.05$ for GLMM). Conclusions: This study suggests that 6for6 improves research competency and productivity for rural physicians. Rural physicians who wish to improve their research competency would benefit from participating in similar programs.

3.2 Key points

- Rural physicians have the potential to create locally relevant solutions to healthcare issues in their local practices. Despite this potential, rural physicians have lacked access to research training programs to pursue their research interests.
- The 6for6 program trained rural physicians to become competent and productive researchers. This quasi-experimental study found that rural physicians have improved research competency and productivity by participating in the 6for6 research training program.

3.3 Introduction

For most rural physicians, engaging in scholarship is challenging. As described in the CanMEDs framework, those who wish to participate in research must pursue "advanced research training." [1] There are six physician competencies in this framework that complement a physicians' role as a medical expert.[2] These roles include the Communicator, Collaborator, Health Advocate, Manager, Professional, and Scholar. Despite the lack of accessibility for rural physicians to engage in formal medical scholarship, the Scholar Role is of notable significance pertaining to their work. These physicians are constantly required to evaluate their practices in order to identify under-researched problems and seek out solutions, proving them to be highly competent in the realm of rural health research.[1,3] While research training is provided during undergraduate medical education and residency, studies suggest that this subject receives limited curricular time.[4,5] Furthermore, advanced research training programs (RTPs) are not accessible to rural physicians once in practice due to geographical and professional isolation as well as a lack of time and funding.[3,6-10]

Rural physicians are often interested in exploring questions related to their clinical practice,[3,10] and bring an important contextual understanding of rural communities to bear on healthcare research.[4,11-14] Given the geographical diversity between rural communities and a gap in rural healthcare research, rural physicians have potential to develop research that yields locally feasible solutions.[11] Their involvement in research would enable medical schools to further address the health concerns of the communities they serve.[15]

Although RTPs do improve research activities among healthcare professionals,[16,17] our literature search found that a limited number of programs are available to support rural physicians' research endeavors in a variety of settings. The clinician-scholar support team in Japan provides online research support for rural physicians,[18] while a few programs in Australia provide research support either in urban or rural settings.[19]-[22]. Furthermore, these programs provide limited support for rural physicians' research activities,[18,19] and only some authors have published assessments of program outcomes, such as research competency and productivity.[20-22] In research, competency is a subjective measure of the relationship between knowledge, attitudes, and skills of an individual that combine to produce results.[23] Research productivity often takes the form of publications, grants, or presentations of research-related work at conferences, and is regarded as an objective measure of research competency.[24]

To empower rural physicians to pursue their research interests, Memorial University developed a research training program called 6for6.[25,26] The purpose of this study is to assess the effectiveness of 6for6 in building research competency (knowledge, attitudes, and skills) and productivity (publications, grants, and presentations of research-related work at conferences) among its participants.

3.4 Methods

3.4.1 Study design

This quasi-experimental study occurred from April 2014 to October 2019 at Memorial University of Newfoundland, comparing research competency and productivity between intervention and non-equivalent control groups, and through a repeated measures design.

3.4.2 Intervention

6for6 is a one-year program focused on developing the research capabilities of **six** rural physicians, taking place through face-to-face sessions over **six** weekends (Friday and Saturday only). Through a blended learning curriculum, participants learn research methods and writing techniques, develop their own research projects with a mentor, and cultivate a research network with other rural physicians. They are also supported by a research assistant.[26] We delivered 6for6 to five different groups of six rural physicians who enrolled in April and graduated in April the following year from 2014 to 2019 inclusive.

3.4.3 Study population & inclusion criteria

Rural physicians practicing in Newfoundland and Labrador, Nunavut, and New Brunswick were eligible to apply. Candidates applied by submitting a letter of interest detailing a research idea related to their local practice, along with a resume and answers to eligibility screening questions. Participants were required to have at least one year of experience practicing in a rural area. Participants were required to have no research training or full-time affiliations at any university prior to the program.

3.4.4 Outcome measures

The primary outcome is research competency, defined as participants' knowledge, attitudes, and skills. Knowledge refers to participants' textbook understanding of research concepts and their ability to recall the information. Attitudes represents the extent to which one views research as valuable and worthwhile. Participants' research skills refer to their ability to put research knowledge into practice.[23]

The secondary outcome, research productivity, refers to participants' publications, grants, and presentations of research-related work at conferences. Any articles successfully published in a peer-reviewed journal, or successful applications for research funding count as publications and grants respectively. Presentations of research-related work at conferences refer to workshops or presentations (poster, oral, or keynote) at local, national, or international research conferences.[24]

3.4.5 Non-equivalent control groups

The control groups were recruited from the pool of rural physicians who expressed interest in 6for6 (see figure 3.1) and later enrolled in the program. By the time of first contact with participants, they had not received any prior research training. For every individual who received the intervention we used up to four controls.

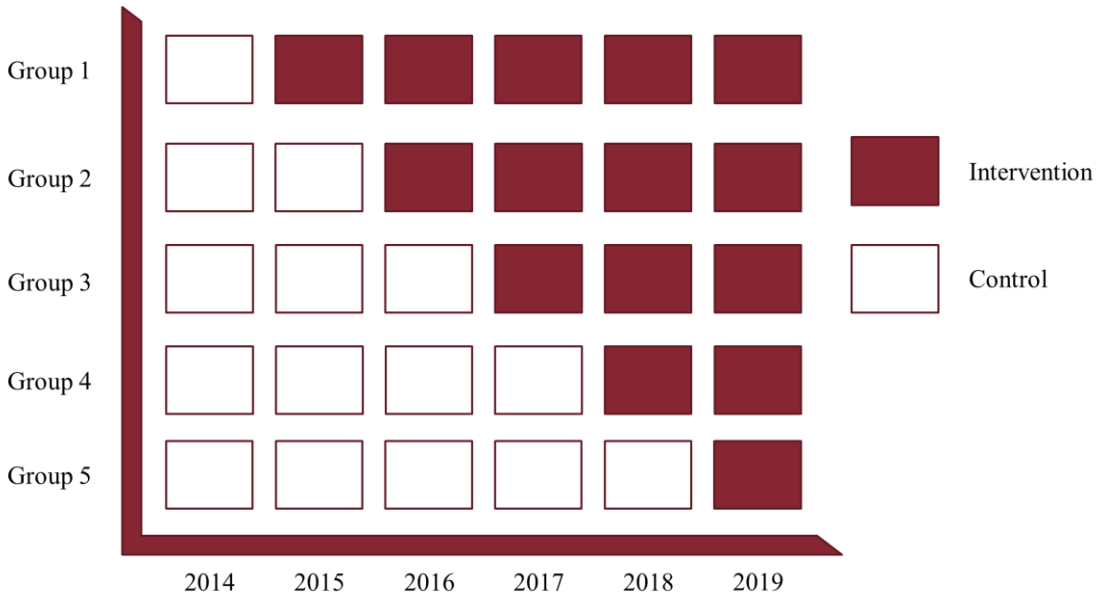

Figure 3.1: Intervention and control group allocation of study participants with the 6for6 research training program

3.4.6 Data collection

Each year we measured participants' self-assessed research competency and productivity at zero months, during the intervention, and at twelve months using the same survey. The pre-program survey was collected at zero months, the interim survey was collected during the intervention, and the post program survey at twelve months. To measure research competency during the program, we divided the competency survey into six sections and delivered them one week after each session; each section corresponded with the topics learned during each session. We combined these survey sections to create the interim-program survey.

Data collected prior to the program represented physicians' research competency before they received the intervention and thus established the control group, while data collected at twelve months represented the intervention group. The GLMM allowed us to compare the intervention group of one year to the control groups of all other years until each year had a chance to represent the intervention group. This approach allowed us to control for the effects of

time. Since each group of participants received the intervention in different years, we did not collect data for the intervention and control groups simultaneously.

Using the research productivity questionnaire, we collected data about participants' productivity before, during, and after the program. We conducted a respondent validation questionnaire in September 2019 to verify the accuracy and recency of this information. We used productivity data collected at zero and twelve months to compare the control and intervention groups through a GLMM.

To improve response rates, we reminded participants three times to complete the surveys at two-week intervals.

3.4.7 Data analysis

We performed descriptive analyses to assess response rates to the surveys and questionnaires and demographic characteristics of the participants.

To assess the change in research competency over time, we used a two-way, repeated measures ANOVA where we compared the mean differences between scores in the pre-, interim- and post-program surveys. We used a generalized linear mixed model (GLMM) to compare the post-program survey scores of intervention groups with the pre-program scores of control groups.

For research productivity, we conducted a repeated measures analysis using the Cochran Q test to determine changes over time (before, during, and after 6for6). To assess for differences in research productivity rates between intervention and control groups, we calculated the number of research products per 100 person-years and analyzed the data using a GLMM.

We performed all analyses in R studio, with a p value of less than 0.05 being considered significant. For both research competency and productivity, we controlled for differences within and between groups using the GLMM. We accounted for differences related to time by including years of practice in the R commands. This study was approved by the Newfoundland and Labrador Health Research Ethics Authority.

3.5 Results

During the 5-year study period, 30 rural physicians enrolled in 6for6, and 19 (63.3%) were female. There were 27 (90.0%) physicians who practiced in Newfoundland and Labrador and three (10.0%) from Nunavut. Approximately 83.3% (n=25) were family physicians, while the remaining participants were from other specialties (n=5, 16.7%). Research competency survey response rates were 100% for the pre-program survey, 93.3% for the interim-program survey, and 76.7% for the post-program survey. When we ran the GLMM the response rate for the control group was 100% and 76% for the intervention group. The response rate for the respondent validation questionnaire was 19 (63.3%). We included all participants in the analysis and assumed that non-respondents had no additional research activities since completing the research productivity questionnaire. No participants dropped out of the program.

3.5.1 Effect of 6for6 on self-assessed research competency

The mean and standard deviation for the pre-, interim-, and post-program questionnaire scores for overall competency were 58.6% ± 14.6%, 61.1% ± 24.4%, and 65.7% ± 37.6% respectively; we observed no significant differences between these scores through the repeated measures analysis. The repeated measures analysis indicated a significant decrease in participants' attitudes toward research between the pre- and interim-program surveys, and a significant increase between the interim- and post-program surveys (mean differences: -31.9%,

p<0.005 and 19.4%, p<0.05). A summary of these results can be found in Table 3.1, which also includes the results for research knowledge, attitudes and skills.

Table 3.1: Research competency scores of 6for6 participants who completed the pre-, interim-, and post- program surveys (n=30)

	Survey Scores *(Mean ± SD)*		
Competency	Pre-Program	Interim	Post-Program
Overall	58.6% ± 14.6%	61.1% ± 24.4%	65.7% ± 37.6%
Knowledge	48.3% ± 14.9%	55.8% ± 26.4%	65.3% ± 37.5%
Attitudes	84.1% ± 19.0%	52.2% ± 34.6%(#)	71.7% ± 40.7%(†)
Skills	48.3% ± 15.4%	50.6% ± 25.5%	62.4% ± 36.1%

 # significantly different than pre-program score, P value for repeated measures ANOVA<0.05
† significantly different than interim-program score, P value for repeated measures ANOVA<0.05

The results of the GLMM showed differences in mean competency scores between the intervention and control groups (Table 3.2), which revealed significant increases between the pre- and post- program scores in overall research competency (mean and standard deviation: 58.6% ± 14.4% and 65.7% ± 37.6%, p<0.05).

Table 3.2: Research competency scores of 6for6 participants in intervention and control groups (n=30)

	GLMM *(Mean ± SD)*	
Competency	Control	Intervention
Overall	58.6% ± 14.4%	65.7% ± 37.6%*
Knowledge	48.3% ± 14.7%	65.3% ± 37.5%**
Attitudes	84.1% ± 18.7%	71.7% ± 40.7%**
Skills	48.3% ± 15.2%	62.4% ± 36.1%**

** < 0.05, **<0.0005, P value for GLMM*

3.5.2 Effect of 6for6 on research productivity

The percentage of participants who were productive was 26.7% before, 16.7% during, and 50.0% after 6for6. Table 3.3 shows the repeated measures results for all components of productivity. The results of the Cochran Q test demonstrate that the proportion of participants

who published articles after the program was significantly higher than before and during 6for6 ($p<0.05$).

Table 3.3: Research productivity of 6for6 participants before, during, and after the 6for6 program (n=30)

	Research Productivity (%)		
Productivity	Before 6for6	During 6for6	After 6for6
Overall	26.7%	16.7%*	50.0%†
Publications	3.3%*	6.7%*	30.0%#†
Grants	6.6%	16.7%	26.7%
Presentations of research-related work at conferences	16.7%	6.7%	26.7%

 # significantly different than before 6for6, P value for Cochran Q test <0.05
† significantly different than during 6for6, P value for Cochran Q test <0.05
** Significantly different than after 6for6, P value for Cochran Q test <0.05*

Overall, the GLMM revealed a significant improvement in productivity rates between the control and intervention groups (rate difference: 72.2 per 100 person-years; 95% CI: -5.5 — 150 per 100 person-years, $p<0.05$). In comparison to the controls, the intervention group had significantly higher publication rates (21.8 ± 48.3 per 100 person-years versus 0.1 ± 0.55 per 100 person-years, $p<0.0005$), rates of secured grants (17.3 ± 33.4 per 100 person-years versus 1.6 ± 6.2 per 100 person-years, $p<0.0005$), and presentations of research-related work at conferences (42.8 ± 160.6 per 100 person-years versus 6.6 ± 19.5 per 100 person-years, $p<0.05$).

Table 3.4: Research productivity rates of 6for6 participants in intervention and control groups (n=30)

	Research Production Rate per 100 Person-Years	
Productivity	*Control*	*Intervention*
Overall	8.4 ± 19.9	80.6 ± 207.6**#
Publications	0.1 ± 0.55	21.8 ± 48.3**
Grants	1.6 ± 6.2	17.3 ± 33.4**
Presentations of research-related work at conferences	6.6 ± 19.5	42.8 ± 160.6*

Rates are per 100 person-years

** < 0.05, **<0.0005, P value for GLMM*
 # One participant produced a large amount of research which contributed to a high standard deviation. The rate difference between intervention and control groups remained significant in all categories after excluding this participant.

The sensitivity analysis for the productivity and respondent validation questionnaires showed that all results were consistent with the original data set.

3.6 Discussion

3.6.1 Interpretation of the results

This study shows that 6for6 increases rural physicians' research competency and productivity compared to the control groups. Our results are consistent with other studies.[18,20] Although knowledge, skills, presentations of research-related work at conferences, and grants increased by the end of the program, the repeated measures analysis demonstrated that these results were not significant. This could be due to the small sample size of the study. For an example, the rural research capacity building program in Australia found significant increases in research experience scores and publication rates with high sample sizes.[20,21]

The sensitivity analysis found that results for competency and productivity were consistent in all categories except for attitudes. This is consistent with previous studies which suggest that building positive attitudes toward research takes time.[27,28] 6for6 participants could possibly benefit from spending more time in the program.

The availability of external research support could be a factor in research productivity outcomes. In this study, alumni who worked in the Labrador-Grenfell regional health authority were eligible to apply for grant funding through an extension program of 6for6.[29] We conducted a sensitivity analysis by excluding those who were eligible for these grants (n=4). Although the effect size of the productivity rate decreased, the results remained significant. This suggests that

similar interventions are effective, however additional support from an external source seems to contribute to an increase research productivity.

One may suggest that undergraduate and postgraduate medical training programs should undergo curricular innovations to improve research skills. Although these programs have made improvements to better engage medical students in research, medical graduates often lose their motivation to pursue research.[30,31] As such, 6for6 is still needed to encourage rural physicians to engage in research.

3.6.2 Limitations

This quasi experimental study using non-equivalent control groups should be interpreted in light of its limitations.

Some aspects of the program's delivery limit our findings. While alumni who participated earlier during the study have had more time to produce research, those from later years may have benefitted from program improvements. These improvements applied to the content delivered, session activities, daily schedule, and personnel involved in the study. To control for these factors, we used a GLMM with random effects to compare research competency and productivity between groups. We found no significant differences. To further address this limitation, the program established a "Come Home Year," where previous participants were invited for a weekend retreat to reconnect with mentors and discuss new and existing research projects.

The study design has limitations. Since no alternative version of this program was available, randomizing participants into additional groups and blinding were impossible. As

such, the quasi-experimental study was the most feasible approach to assess the effect of the intervention.

The number of survey items increased over time, potentially influencing survey performance of participants from the final three years of the study. We controlled for the effect of time and found no significant differences between groups with different survey lengths.

While 6for6 helps rural physicians surmount their isolation barriers, participants may experience them after graduation and therefore their productivity may be impacted. For participants working in the Labrador-Grenfell regional health authority, there is an option to submit their proposals and pursue their research projects further through an extension program,[29] however not all participants have this option. To mitigate this limitation, the 6for6 team continues to work with all participants who are still completing their projects, applying for grant or ethics applications, and those who wish to publish or present their findings.

One participant produced a high amount of research in comparison to the rest of the groups. While the literature suggests that this phenomenon is common for RTPs,[20] there is potential that prolific research production from a single participant can skew the results. We conducted a sensitivity analysis by removing this participant and found no changes in the results.

Non-response bias is a limitation of this study due to incomplete surveys and questionnaires. To mediate this bias, we imputed data to test the consistency of the results with several scenarios (e.g., best- and worst-case scenarios).

Due to a small sample size and to ensure confidentiality, we could not control for variables such as sex, specialty, or years of practice. As a result, we were unable to match the intervention groups to the controls based on years of practice.

Future research would also benefit from a larger sample size so that possible moderating influences, such as sex, specialty, and years of practice could be assessed.

The Hawthorne effect is another limitation, where participants were aware of their involvement in this research study and could potentially change their behaviour to affirm the hypothesis. There were several measurements during and after the study period, however we did not see a shift in the findings over time.

Some tests may be significant due to multiple testing. We adjusted the p values in the repeated measures analysis and GLMM for research competency and productivity. All results remained significant except for overall research competency scores in the GLMM and the rate of presentations of research-related work at conferences per year.

Nonetheless, to fully assess the effect of experience with the passage of time, it is important to follow participants for a longer period of time. Statistical controls, while very useful, do not capture the myriad context effects that might occur in the multifaceted environment studied here.

3.6.3 Suggestions for future study

Future research would benefit from a longer time frame to ensure participants have enough time to finish their research projects. This alternative option would allow participants to publish their work by the end of the study and enable researchers to use additional measures of productivity such as citations counts, first author publications, or the amount of grant money awarded. Future studies could compare the effectiveness of their RTPs to a virtual stream for rural physicians who prefer to learn from home. This could benefit participants who wish to reduce the amount of travel required to pursue research training. Lastly, future studies could

assess collaborations between participants within the same cohort, between participants from different provinces and territories, or continued relationships between mentors and mentees.

3.7 Conclusions

Rural physicians lack the resources to develop as researchers. This study found that 6for6 enhances research competency and productivity among rural physicians. Although overall research competency and productivity increased between the intervention and control groups, attitudes toward research remain inconclusive. 6for6 is the first program in Canada that helps rural physicians conduct research in the communities they serve. A program like 6for6 can help rural physicians develop research projects relevant to their patients and practice.

3.8 Contributions

All authors substantially contributed to the conception of this study. CM and SA designed the study, analyzed the data, interpreted data, and prepared an early draft of the manuscript. All authors provided critical review and feedback for the manuscript and approved it for publication in the Canadian Journal of Rural Medicine.

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Chapter 4: Summary

This thesis had two objectives: to establish a framework for the evaluation of a research training program (RTP), and to determine the effectiveness of 6for6 in developing the research competency and productivity of rural physicians. Overall, the intervention group had higher research competency scores and productivity rates than the controls. Research competency scores (mean ± standard deviation) were 65.7% ± 37.6% in the intervention group and 58.6% ± 14.4% for the controls ($p<0.05$), whereas productivity rates (± standard deviation) were 80.6 ± 207.6 per 100 person-years in the intervention group in comparison to 8.4 ± 19.9 per 100 person-years for the controls ($p<0.0005$). The results suggest that rural physicians developed their research competency and productivity by participating in activities such as sponsored travel, lectures, workshops, mentoring, eLearning, peer consultation, and individual and group activities. The connections between these activities and their predicted outcomes were established in a logic model and can be modified to reflect 6for6 as it undergoes improvement. As evaluation questions are answered in the evaluation matrix, new connections may be established between logic model components to reflect improvements.

It is likely that 6for6 is the first rurally focused RTP to publish a logic model and an evaluation matrix. The literature search showed no evidence that similar RTPs have published such evaluation tools. While Webster and colleagues refer to a logic model regarding their program evaluation, no publication of this logic model appeared in the literature search for this thesis.[1] The 6for6 logic model illustrates the process through which rural physicians are able to develop their research capabilities. The evaluation matrix contains a collection of questions and methods related to the improvement of the 6for6 program. These findings will be useful for program planners who are interested in training rural physicians in research. The 6for6 logic

model will enable other institutions to understand which activities should be used when developing similar programs. Once similar programs are established, other institutions will find that developing an evaluation matrix can help establish the parameters of their evaluation and determine the amount of resources to be used for program improvement.

Research competency and productivity among 6for6 participants was assessed using several unique approaches. Methods of analysis such as the GLMM, repeated measures analysis, and Cochran Q test allowed for the data to be assessed in a variety of ways. These analyses established the intervention and control groups and assessed changes over time. Furthermore, the GLMM controlled for random effects, which accounted for changes in the delivery of 6for6 and differences between each participant. Both program planners and rural physicians with an interest in research development would be interested in these findings. After reading these results, rural physicians who experience barriers in pursuing research will learn that RTPs such as 6for6 are feasible and effective. Rural physicians may also learn that participating in RTPs and pursuing research projects can help them discover locally relevant solutions for their practices.

The results for research competency and productivity are consistent with the literature, revealing that rural clinicians benefit from accessible RTPs. Four rurally focused RTPs have published studies describing their effect on similar outcomes. The research capacity building program, as described by Schmidt and colleagues, conducted a cross-sectional study assessing self reported research experience among participants.[2] These results show significant improvements in research experience scores, where research experience increased from 2.2 (standard deviation = 0.5) to 2.8 (standard deviation = 0.5) on a five-point Likert scale.[2] A study by McIntyre and colleagues reported that participants in their researcher development program

significantly improved their research knowledge, attitudes, and practice as indicated by self-completed surveys.[3] The results suggest that some participants incorporated research into their careers, and most participants were able to either present or publish their research.[3] The third RTP in Australia found that their participants had a positive experience with the program and benefitted from a supportive workplace.[1,4] These program participants also had the option of pursuing a writing for publication program after graduating.[5] Those who participated in the writing for publication program had an overall publication rate of 0.80, while those who did not had a publication rate of 0.23.[5] Finally, the research support team at Jichi Medical University in Japan found that out of the 41% of clients who published papers in peer-reviewed journals (11 out of a total of 27 clients), approximately 91% were satisfied with the program.[6]

Despite the numerous strengths of this thesis, there remain some limitations. 6for6 relies on the Faculty of Medicine at Memorial University for many resources. Other institutions may have different resources available to them, and therefore the 6for6 logic model may not be transferable to these institutions. Ultimately, the logic model depicts 6for6 through a simplified lens, portraying how it delivers resources to rural physicians in a theoretical format and excluding any real-life variables.

Another limitation is that 6for6 is a one-year program. The literature suggests that building research competency and productivity within one-year is difficult.[7,8] Studies have found that clinicians require as much time as possible to build positive attitudes toward research.[7,8] The results in this thesis also found that not all 6for6 participants were able to build positive attitudes toward research within a one year span. To address this issue, the 6for6 team created the Rural360 program to provide continued support for 6for6 participants. In this program, eligible participants can apply for grant funding to continue their projects, thus giving them more time to

complete their projects. Preliminary findings suggest that this extension program is effective at helping 6for6 graduates complete their projects through continued support.[9]

While the 6for6 evaluative framework portrays many avenues to evaluate 6for6, only several questions can be answered at the present time. This thesis provides an evaluation of a short-term outcome regarding research competency and productivity. In future, questions regarding medium-term outcomes and long-term outcomes could be answered. The impact of 6for6 on the development of research networks and on participants' research projects regarding improvement of healthcare services are outcomes worthy of study. Exploring other areas of interest may require several more years of data collection. While this thesis focused on quantitative data, the 6for6 researchers are currently processing qualitative data which will be available through future studies. As evaluations such as these take time, institutions developing similar programs should commence data collection as early as possible.

This thesis describes a detailed process for evaluating an RTP for rural physicians and suggests that similar RTPs are likely to have a positive effect on their research development. Depending on their capacity and willingness to dedicate time for pursuing research projects, rural physicians have the potential to create innovative solutions for healthcare issues in their rural communities. Programs like 6for6 can increase the amount of research in rural healthcare and improve research competency and productivity among its participants. This logic model provides a lens into the process through which these programs are built and can help faculty development researchers formulate similar programs elsewhere. By developing this logic model and evaluating the short-term effectiveness of 6for6, this thesis shows that programs similar to 6for6 can be established at other institutions and be highly beneficial for rural physicians.

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Appendix A: Evaluation matrix of the 6for6 research training program for rural physicians

Themes	Evaluation Questions **Blue = Linked to participant logic model** **Red = Linked to program logic model** **Yellow = Overarching questions of interest**	Indicators	Data Collection Method	Use of Findings	Logic Model Connections	Responsibility	Time Frame
Relevance	To what extent does the 6for6 program meet the needs of rural and remote physicians and their communities?	• RRP perspectives • Community perspectives • Existence of similar programs in other jurisdictions	• Pre-post session surveys • Pre-post program community needs assessment • Focus groups • Environmental/literature Scan	To better understand how 6for6 is successful in meeting the needs of rural and remote physicians and their communities, and identify how this can improve.	Activities: Needs assessment		
	How does the 6for6 program align with the strategic plan and the various departments within the Faculty of Medicine?	• Degree of alignment with other programs' visions, missions, and/or strategic plans • Mentor, faculty, and staff perspectives	• Pre-post session survey • Pre-post program community needs assessment • Document review • Interviews	To understand how 6for6 aligns with the the Faculty of Medicine's goals for excellence and whether this aligment can improve.	Activities: Program development and implementation/stakeholder engagement External factors: Faculty vision		
	Is there an ongoing need for 6for6?	• Mentor, faculty, staff, and participants' perspectives • Reported community research needs • # of applications received annually • Quality of applications received	• Pre-post session survey • Pre-post program community needs assessment • Document review • Interviews • Focus groups	To understand how existing or new faculty development programs are addressing rural physicians' research training needs, and whether this affects the need for a program like 6for6.	Activities: Needs assessment/continual program monitoring STO: Program aligns with rural physicians' needs MTO: Program expanded to include all rural health professionals External Factors: Community needs/Research interest		

Design and Delivery	Is the 6for6 program delivered as planned? a) How has the 6for6 program changed its design and delivery over time? b) Are there facilitators/barriers to the delivery of 6for6?	• Degree of changes to session agendas • Changes reported in meeting minutes • Mentor, faculty, staff, and participant perspectives	• Pre-post session survey • Document review • Interviews • Focus groups	To determine if 6for6 is being implemented as planned, and if not, why and whether course this needs to change.	Activities: Program development and implementation/continual program monitoring Outputs: 6for6 program deliverables/Program changes
	To what extent do mentors, participants, staff and other stakeholders have a positive experience in 6for6?	• Mentor, faculty, staff, and participants' perspectives • Scholarly activity of participants (# conferences attended, #research presentations and publications, #/$ grants received, # projects conceptualized)	• Pre-post session survey • Document review • Focus groups	To gain a better understanding of the journeys of 6for6 participants, including successful components of the program and potential areas for improvement	Activities: Sponsored travel/expert mentoring/peer consultation/workshops and lectures/individual and group activities/eLearning Outputs: Campus visits/Educational modules completed
Access & Reach	Is 6for6 reaching its local, national, and international audience? a) Are people aware of 6for6? b) What are the facilitators/barriers to rural and remote physicians from accessing 6for6?	• Faculty, participant awareness • # of events in which 6for6 is promoted • # of applications received annually • Geographic spread of applications • Web analytics • # of citations in the academic literature • # of media features	• Pan-faculty survey • Document review • Focus groups • Interviews	To understand how 6for6 is perceived by its audience and whether improvement is possible.	Activities: Stakeholder engagement STO: Increased awareness of 6for6 MTO: Increased national and international awareness of 6for6 External factors: Research interest

Effectiveness & Efficiency	Is 6for6 increasing participants' access to research resources and mentorship?	• Mentors, faculty, staff, rural and remote physicians, and 6for6 participants' perspectives • Reported use of library resources • Reported use of RA support • Reported use of MUN eLearning supports • # of meetings with mentors	• Pre-post session survey • Pre-post program needs assessment • Document review • Interviews • Focus groups	To identify if 6for6 participants feel that they have better access to research resources and have made research connections as a result of their participation in 6for6. .	Output: New relationships STO: Increased awareness of research resources and supports available to rural physicians
	Does participation in 6for6 contribute to improved knowledge exchange among RRPs?	• Mentor and paticipants' perspectives	• Focus groups • Pre-post session survey • Interviews	To identify the role 6for6 plays (if any) in knowledge exchange among RRPs.	STO: Improved Knowledge exchange for rural physicians
	Has 6for6 contributed to an increase in scholarly activity among rural and remote physicians? a) Does 6for6 catalyze rural health research?	• Research competency survey scores • # of conferences attended by participants • # of publications/grants by participants • # of research projects conceptualized • Research content in participants' CVs before/after 6for6 • Inclusion of 6for6 into academic curriculum of Memorial University • Mentors, staff and 6for6 participants' perspectives	• Pre-post session survey • Pre-post program needs assessment • Document review • Interviews • Focus group	To identify any connections between 6for6 and scholarly activity within the local communities of 6for6 participants?	STO: New evidence contributed to knowledge base MTO: 6for6 is a university course STO: Enhanced research knowledge and skills for rural physicians MTO: Increased participation and collaboration by rural physicians in scholarly research

	Is the program operating efficiently? a) Where & how efficiently does 6for6 allocate its funds? b) What factors prevent or enable efficient delivery of 6for6?	• Expenses/awards noted in program records (meeting minutes, budgets, financial reports, annual reports, etc.) • Faculty, staff perspectives	• Document review • Interviews	To establish a plan to improve program efficiency and identify opportunities for cost savings.	Inputs: Operational resources