

Community-Engaged Scholarship to Catalyze Innovation: A Case Study of the Uptake of Metered-Dose Inhalers with Spacers to Deliver Respiratory Medication in a Pediatric Emergency Department in Nova Scotia



COMMENTARY

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ABSTRACT

This commentary, in response to Tamblyn et al. (2016), provides a case study of the uptake of metered-dose inhalers with spacers to deliver respiratory medication in a pediatric emergency department in Nova Scotia. Our objective was to demonstrate the opportunities and challenges in engaging researchers and their trainees in planning and evaluating a clinical practice change to improve drug therapy. We document the use of community engaged scholarship (including experiential learning) to increase the capacity and capability of researchers in academia and healthcare organizations, healthcare providers, and managers. We note lessons learned from Dalhousie University's Drug Use Management and Policy Residency and four individual research projects conducted between 2006–2016.

Introduction

The optimal use of pharmaceuticals is a key component of a safe, effective and sustainable healthcare system, yet prescribing, medication management and pharmaceutical policy often lag in implementing recommendations from scientific evidence. Tamblyn et al. (2016) note the high level of healthcare spending in Canada compared with other Organisation for Economic Co-Operation and Development (OECD) countries. Canada spends US\$761 per capita on pharmaceuticals. This is higher than the OECD reported average (2015) of \$527 USD per capita, and ranks 29th of 30 countries. The Canadian Institute for Health Information (CIHI) reports (2015) that 15.7% of healthcare spending is directed toward pharmaceuticals (\$959 CAD per capita). Canada, without a comprehensive national pharmaceutical strategy with quality indicators, has identified and unidentified performance gaps in prescribing and pharmaceutical use in areas such as access, safety, quality and value for money.

Tamblyn et al. (2016) note the need for conducting and learning from natural experiments in health service delivery in Canada. Various approaches are being implemented by Canadian public and private sector organizations to improve prescribing and medication use focusing on the patient, provider, organization and/or system levels; however, these

are often implemented for a specific patient population or jurisdiction with limited spread across the country (Sketris et al. 2009).

This paper presents a case example, a series of studies around the uptake of metered-dose inhalers with spacers (MDIs) for respiratory medication delivery in a pediatric emergency department (PED) in Nova Scotia. Throughout this case, we sought to increase capability and capacity of health services researchers, and innovation in the healthcare system using community-engaged scholarship including experiential learning. Our approach paired scientists in academia with policy, clinical, managerial and research leaders in the health system to co-produce research.

The case highlights two strategic directions identified by the Canadian Health Services and Policy Research Alliance: (1) accelerating the creation of a cadre of scientists working in a learning health system and (2) measuring research impact (CIHR Institute of Health Services and Policy Research 2014). The case also highlights two themes that have received limited health services research funding, identified by the Alliance's 2007–2012 scan of 27 federal and provincial health research funding agencies and health charities: managing for quality and safety (receiving 11.9% of total health services research funding) and change management (receiving only 0.3%) (Tamblyn et al. 2016).

DUMPR and DEANS

In 1999, the Canadian Health Services Research Foundation (CHSRF) in partnership with the Canadian Institutes of Health Research (CIHR) launched the Capacity for Applied and Developmental Research and Evaluation in Health Services and Nursing (CADRE program) with \$6.5 million in annual funding (Grudniewicz et al. 2014; Potvin and Armstrong 2013; Tamblyn et al. 2016). Under this program, Ingrid Sketris received a Chair, which allowed her to form partnerships to conduct pharmaceutical policy research in Nova Scotia. This Chair used community-engaged scholarship and operated in Mode 2 research (co-production of research with relevant provincial government departments and healthcare organizations). One component was the Dalhousie Drug Use Management and Policy Residency (DUMPR), an experiential learning approach that embedded trainees (38 in total) with the support of their academic advisors in organizations to conduct research of relevance to their decision-making preceptors (Conrad et al. 2005, 2013).

Some of the key components of community-engaged scholarship and the experiential learning program used in the case are noted below. While they are presented linearly, academics and healthcare decision-makers interacted frequently with multiple planning iterations and processes that may or may not have occurred concurrently.

Establishing Key Partnerships

DUMPR leveraged the Drug Evaluation Alliance of Nova Scotia (DEANS), which was established in 1998 by the Nova Scotia government to provide a secretariat for and funding of pharmaceutical prescribing and use improvement interventions. DEANS identifies and prioritizes critical drug therapy issues, analyzes scientific evidence and connects

with local clinical expertise to understand and improve drug therapy. Along with partners, DEANS develops, implements and evaluates interventions to increase the uptake of evidence-informed practices and policies (Sketris et al. 2006).

Lessons learned and future considerations

Many trainees' research topics originated from issues identified by DEANS. As trainees presented research results to DEANS, they received feedback from a broad group of practitioners and policy makers, advice on research dissemination channels and suggestions for future research. More formal and long-term approaches to developing research priorities could be developed, taking into account the priorities of both the academic and decision-maker organization.

DEANS identifies and prioritizes critical drug therapy issues ...

Utilizing the Academic Health Sciences Network

Our case example was set at the IWK Health Centre, which has a memorandum of understanding with Dalhousie University for student placements and a mission of patient care, education and research (Brimacombe et al. 2010). Tamblyn et al. (2016) discuss the need for research in geriatrics. However, our case addresses children who are similarly vulnerable because randomized controlled trial (RCT) evidence can be limited (Council of Canadian Academies 2014).

Lessons learned and future considerations

The IWK Health Centre and Dalhousie University partnership facilitated experiential education to allow trainees and their academic advisors, especially those without clinical backgrounds, to conduct or participate

in research in healthcare settings. Canada's Strategy for Patient-Oriented Research (SPOR) may involve rural, primary and continuing care organizations, and these partnerships could be expanded to improve drug use outside academic settings. Further ties (both formal and informal), and mechanisms to integrate research strategies of the health system and academia could be developed, such as those in the UK's academic health sciences centres' networks, and Collaborations for Leadership in Applied Health Research and Care (CLAHRC) and other partnerships (Graham and Tetroe 2009; Rycroft-Malone et al. 2011; Sibbald et al. 2014; Soper et al. 2015; Spyridonidis et al. 2015).

Identifying the Drug Policy Issue for Intervention

With over 15,000 marketed drug products and many gaps in optimal prescribing, the research teams identified priorities (Sketris et al. 2009). The initiative to increase the uptake of MDIs in the delivery of respiratory medications for children who wheeze was noted as a priority by the clinical leadership at the IWK PED. One of the members of our clinical leadership, Dr. Douglas Sinclair (then Chief of Emergency Medicine), had been part of the earlier DEANS initiative to increase the uptake of MDIs in adults and was able to build on this experience. For adults, DEANS developed and evaluated educational, drug reimbursement policy and financial incentives to hasten the uptake of MDIs (Bowles et al. 2007; Kephart et al. 2005; Lowe et al. 2008; Murphy et al. 2005). The evaluations noted that the interventions resulted in a three-fold decrease in respiratory medication delivered by nebulization and approximately \$1 million in annual drug cost savings to the Nova Scotia Seniors' Pharmacare Program (Kephart et al. 2005; Sketris et al. 2006). This approach had not yet been taken up in pediatric patients.

Lessons learned and future considerations

Experience in adults related to increasing the uptake of MDIs could be adapted for children. In the future, gaps in optimal prescribing identified by other organizations (e.g., National Prescription Drug Utilization Information System) and pan-Canadian approaches to improve drug therapy (e.g., Canadian Agency for Drugs and Technologies in Health, Choosing Wisely Canada) could be better leveraged to improve drug use in Nova Scotia.

Assembling a Research Team

Conducting research often requires multi- and transdisciplinary teams and collaboration across academic and healthcare organization boundaries (Denis et al. 2003; National Research Council (NRC) 2015). We had access to and employed the skills of 14 researchers with diverse backgrounds (Table 1). The team had multilevel learners: one Masters student in health informatics and one in library and information sciences, one PhD student in economics and one medical student. While we worked with our DUMPR trainees, the IWK Emergency Department hosts about 150 medical students per year and many medical residents and students of other health professions who may have also been exposed to the intervention.

Four pediatric respiratory medication research projects were conducted from 2006 to 2016 (Table 2). Healthcare practitioners were interested in improving quality quickly to enhance safe and effective care. Researchers were also interested in applying theories and rigorous methods to produce generalizable knowledge (Bauer et al. 2015). The team established common objectives, invested time to build trust, and negotiated approaches, timelines, priorities and financial and human resources to improve healthcare quality and advance science.

Table 1. Skillsets for multi- and transdisciplinary team involved in research on intervention to increase uptake of salbutamol metered-dose inhalers (MDIs) and spacers for a pediatric emergency department

Skillset	Team member
Emergency medicine, clinical leadership	Ducharme, J.
Psychology, organizational behaviour, statistics	Duffy, J.
Pharmacy, library and information science	Hill-Taylor, B.
Emergency medicine, health informatics	Hurley K,.
Statistics, including time-series analysis	O'Connell, C.
Qualitative research, learning theory	Sargeant, J.
Emergency medicine, clinical leadership	Sinclair, D.
Pharmacy, health services research	Sketris, I.
Pharmacy, Pharmacy Information Management Systems	Smith, J.
Health Economics	Spin, P.
Health Informatics, Statistics	Stewart, S.
Health Economics	Ward, C.
Medical Student Researcher	Wing, A.
Health Economics	Xu, K.

Table 2. Timeline for experiential learning related to intervention to increase uptake of salbutamol metered-dose inhalers (MDI) and holding chambers for a pediatric emergency department

Event	Year
Hurley begins Drug Use Management and Policy Residency Program and studies barriers to intervention	2006
Intervention begins at the emergency department of IWK Health Centre	2006
Hurley et al. publish information on barriers identified using focus groups and interviews	2008
Hill-Taylor begins Drug Use Management and Policy Residency Program and evaluates the uptake of salbutamol MDI and holding chambers as a result of intervention	2010
Wing begins Osman Medical Student Summer Research Studentship and examines quality of salbutamol dispensing data using automated dispensing machine	2010
Spin begins studentship and conducts economic analysis of the conversion from salbutamol nebulization to MDI and holding chambers	2011
Wing et al. document the discrepancies between paper and electronic records from automated dispensing machine	2012
Hill-Taylor et al. document rapid uptake of MDI and holding chamber	2013
Spin et al. document an estimated \$270,000 CDN per annum cost savings as a result of the intervention	2016

Lessons learned and future considerations

The teams' methods of operation were facilitated by the DUMRP, which defined roles and responsibilities for trainees, preceptors

and faculty advisors, and provided trainees with frequent in-person and electronic communication and an ongoing support network; however, team science has developed

and provides further research and training guidance (Conrad et al. 2005, 2013; Forrest et al. 2009; Morgan et al. 2010; National Research Council 2015). Patients, families and voluntary health organizations had limited involvement in the research process and this could be strengthened.

... researchers need to understand the context in which to apply evidence and conduct research ...

Identifying Evidence Sources and the Gap between Evidence and Practice

Multiple sources of evidence were gathered and critiqued: scientific literature, an environmental scan of PEDs (Osmond et al. 2007; Scott et al. 2009) and a site visit to the Saint John Regional Hospital, New Brunswick, where the switch to MDIs had already been adopted, and where Dr. Katrina Hurley, who was a DUMPR trainee, had trained as a resident. As early as 1984, there was evidence that MDIs were at least equivalent to nebulization in children with acute asthma (Frelander and Van Asperen 1984). By 1997, there were recommendations that MDIs be considered the preferred mode of treatment in children with acute exacerbations of asthma and over the next years evidence was strengthened as multiple trials, syntheses and guideline recommendations were published. (Appendix 1 [available at: <http://www.longwoods.com/content/24726>] contains a record of publications related to the use of MDIs versus nebulization in children with acute wheezy illnesses. This literature search was conducted by another DUMPR trainee, Barbara Hill Taylor.) Following this literature scan, investigators appraised and synthesized relevant articles for specific presentations. By 2006, when the intervention was being planned, evidence showed that the two treatment methods could no longer be considered equivalent for most pediatric

asthma emergency cases. There was established evidence that MDIs offered clinical and societal benefits, with potential for a better comfort and safety profile (Hill-Taylor et al. 2013).

Lessons learned and future considerations

Multiple evidence sources needed to be acquired, synthesized and exploited to plan the intervention and research (Zahra and George 2002), and teams were needed as the task would be daunting for a single clinician (Greenhalgh et al. 2014). This speaks to the ongoing need for communities of practice comprising healthcare practitioners and researchers to collaboratively identify and address gaps between evidence and practice.

Understanding the Context

Health services researchers need to understand the context in which to apply evidence and conduct research and then determine which aspects will facilitate or hinder their quality improvement and research efforts (Bowen and Graham 2015; Greenhalgh and Fahy 2015; Jackson and Greenhalgh 2015; Sargeant et al. 2008; Squires et al. 2015). There are various definitions of context, for example, from Tuen van Dijk, the “situational, historical, geographical, social or cultural environment of a phenomenon being studied” (Bate 2014: 4).

Our teams included embedded clinician researchers, who practiced in and understood the changing context, and could develop tailored interventions and adapt these over time.

One team examined perceptions surrounding the use of MDIs for delivering respiratory medications in the PED, using focus groups and interviews. Four main themes that needed to be addressed prior to implementing the intervention were identified: workload, misconceptions related to cost, need for education, and clarity related to professional roles (Hurley et al. 2008).

The team also needed to understand the decision-making structures, operational processes (e.g., role of the Quality and Operations Committee), clinical and policy levers and resources available to support the intervention. They needed to determine sources of local support and/or resistance for the intervention as well (Bate 2014).

Lessons learned and future considerations

Our teams learned the difficulties of working in the real world context. We echo Donald Berwick and Paul Bate who note “the punishing contextual terrain,” which “so clearly labels the facts on the ground for ambitious even courageous clinicians, managers, executives and others in healthcare who seek to make care far better” (Bate 2014: 12).

Future work needs to use emerging frameworks and theories in understanding context and provide greater community supports for embedded researchers (Bate 2014; Damshroder et al. 2009).

“The embedded researchers were able to develop a practical intervention ...

Development of the Intervention

The intervention was developed by identifying the scientific evidence and leading practices as well as understanding the local context through qualitative interviews and informal consultations with clinicians and managers (Hurley et al. 2008). The embedded researchers were able to develop a practical intervention, which recognized the clinicians’ strong internal motivations to improve care, and provided them with their own quantitative data, myths uncovered during qualitative research and opportunities to share experiences. It used clinical managers to leverage authority and provided

numerous opportunities to refine the intervention (Pannick et al. 2015; Wieringa and Greenhalgh 2015).

The intervention included the development of an asthma care map (with MDIs as one component) and educational sessions with healthcare providers and patients. The implementation of the care map took over two years – discussions began in 2006. The map was introduced as a pilot in January 2008 and became standard practice in July 2009. Piloting the intervention was key and recommended by the clinical leader, Douglas Sinclair. The intervention also included public service announcements to request that parents bring in their child’s holding chamber when seeking emergency care.

The intervention adhered to the characteristics of simplicity, trialability, observability, reinvention and risk minimization (Ganz et al. 2009), and the team understood that changing clinician mindlines required the incorporation of both scientific knowledge and an understanding of factors that influence practice and decisions to change practice such as leadership, relationships, and personal and group beliefs.

Lessons learned and future considerations

The strong preparation related to understanding the context and assembling multiple sources of evidence as well as involvement of clinicians and managers helped make the intervention successful. We used grounded theory, knowledge translation principles and some aspects of learning theories (Graham et al. 2006; Hurley et al. 2008). Newer theories, models and approaches have much to offer in developing and implementing interventions (Bate 2014; Damschroder et al. 2009; Helfrich et al. 2010; Jagosh et al. 2012, 2015; Riley et al. 2015; Rycroft-Malone et al. 2013; Soper et al. 2015; Swanson et al. 2012; Waltz et al. 2015). Mechanisms need to be put in place for continued learning and adaptation of care maps

as evidence and guidelines change over time (Fleischer et al. 2016; Kastner et al. 2015).

For our intervention, the information technology infrastructure could not be harnessed to provide electronic clinical decision support tools and continues to remain a challenge, making it an avenue for further work.

These interventions were developed within a single institution and knowledge translation opportunities across the province have not been fully exploited; however, care maps are faxed on request to other institutions and Translating Emergency Knowledge for Kids (TREKK) is used as a national knowledge sharing network. Other jurisdictions employ national networks (e.g., Quality Enhancement Research Initiative (QUERI and NPS MedicineWise) to develop and share interventions for large systems with the potential for increased efficiency and effectiveness (Graham and Tetroe 2009).

Developing the Evaluation

There were three evaluation components. Hill-Taylor et al. (2013) examined PED inventory data for salbutamol inhalation formulations and received patient data from decision support services. They found a 1,215% (95% CI 1032 to 1396, p less than 0.001) increase in the proportion of salbutamol delivered as MDIs following the intervention.

To understand medication dispensing data quality, Wing et al. (2012) explored the agreement between salbutamol administration records abstracted from the paper-based emergency department charts and electronic records generated by an automated dispensing device. While they noted substantial agreement (κ 0.71), there were still many discrepancies to address.

Spin et al. created a model for evaluating the cost-effectiveness of both salbutamol inhalation methods (MDIs vs nebulization) using local IWK Health Centre patient chart review and inventory data, Nova Scotia

wages and salaries, and Canadian data from the National Ambulatory Care Reporting system, the Canadian Institutes of Health Information Discharge Abstract Database and Patient Cost estimator, and Statistics Canada (consumer price index) for patient costs, length-of-stay in the PED and hospital (if admitted) and the probability of admission combined with a time and motion study from the UK. (Spin et al. in press) They confirmed that use of MDIs was associated with a lower average patient cost.

Lessons learned and future considerations

Each study contributed not only to the overall evaluation of this intervention but also to the building of datasets and methods for future intervention evaluations. Other aspects that could have been evaluated include documentary evidence related to the implementation process and fidelity, resources and costs used in the development of the intervention, qualitative approaches to determine clinician satisfaction with the intervention and remaining barriers and patient perspectives.

In future projects, we could better use theory-based evaluation, evaluate contribution of the research process to the outcome and determine endurance and adaptations of the innovation (Bate 2014; Fleischer et al. 2016; Soper et al. 2015).

Incentives and Disincentives for Community-Engaged Scholarship and Experiential Learning

Tamblyn et al. (2016) note the need for incentive systems for health system innovation and the need to align incentives to further the engagement of practitioners in the innovation process. Our case provided value to the healthcare system by facilitating, documenting and evaluating the switch to a more cost-effective approach to deliver drug therapy in pediatric patients who wheeze.

It was facilitated by a studentship award to Katrina Hurley and others and a chair award to Ingrid Sketris. Physician compensation models, which include not only clinical care but also quality improvement and research, may assist in their involvement in community-engaged scholarship to improve health-care system performance, but accountability frameworks and performance measurement systems may be difficult to establish as these new payment models emerge (Damschroder et al. 2014; Hanney and Gonzalez-Block 2014; Soper et al. 2015; Wilsdon et al. 2015). Clinician scientists need time for practice reorganization, quality improvement activities and/or research and incentives to move up the clinical scientist or managerial ladder and to continue to engage in community-engaged scholarship (Belkhodja 2014; Harvey et al. 2015).

Our teams produced five papers, received best oral presentation awards at local departmental and faculty-wide research days, and a poster award at the 2015 CAPHC (Canadian Association of Paediatric Health Centres) national conference. We also presented our research over 20 times to various decision-making audiences, locally and nationally. These awards, presentations and publications can be used by academics in their submissions for tenure and promotion files, and salary and operational grant competitions. Our teams conducted evaluations consistent with the human and financial resources available, but did not comprehensively examine research impact (Bauer et al. 2015; Panel on Return on Investment in Health Research 2009; Soper et al. 2015).

... accountability frameworks and performance measurement systems may be difficult to establish ...

Conclusion

This case, which examined an intervention and its evaluation between 2006 and 2016, has been used to illustrate how community-engaged scholarship including experiential learning can catalyze the improvement of healthcare, specifically in the improved delivery of medication for children with acute exacerbations of asthma in a PED, and can decrease overall healthcare costs.

Creating and maintaining a collaborative learning system and trusting partnerships across academic and health services delivery organizations, and engaging embedded health service researchers, were key to the success of our intervention. A vision, strategy and process could be developed to expand relationships to other patient populations and across other healthcare and social care organizations. The result of these productive relationships between academia and the health system can lead to increased health services researcher capacity and ongoing rigorous and relevant research and knowledge translation so needed in meeting the challenges of healthcare transformation, as outlined by Tamblyn et al. in their paper.

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