# research

# Understanding whole systems change in health care: insights into system level diffusion from nursing service delivery innovations – a multiple case study

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Our study responds to calls for theory-driven approaches to studying innovation diffusion processes in health care. While most research on diffusion in health care is situated at the service delivery level, we study innovations and associated processes that have diffused to the system level, and refer to work on complex adaptive systems and whole systems change to guide our work. System-level diffusion not only involves the spread of innovations across sector boundaries in a system, it may alter interactions and care delivery within multiple system components, change the nature of the interdependencies between components, and ultimately lead to whole systems change.

**key words:** innovation diffusion • whole systems change • evidence-informed practice change

## Background

### *Study objectives: pursuing insights into system-level diffusion and whole systems change*

The purpose of our study was to contribute to understanding the processes and factors that influence system-level diffusion of complex health care delivery innovations, and to gain insights into how the diffusion of innovations can manifest as *whole systems change* (WSC).

We focused on evidence-informed nursing service delivery innovations, or ENSDIs. We defined ENSDIs as transformative models for health services delivery that cross health care sectors, involve multiple strategies, and engage decision makers at various levels in implementation. They are primarily delivered by or involve the work of nurses.

Our primary research question was:

What factors contribute to the development, application, and diffusion of best evidence that comprise ENSDIs such that they are viable beyond the boundaries of the social system in which they originate, and achieve system-level diffusion?

We referred to ENSDIs with viability beyond the boundaries of the social systems in which they were conceived as having 'high system potential' – or, the potential to effect WSC. Identification of factors that contribute to high system potential, in particular those factors that are modifiable, is of general utility to those interested in the uptake of research into practice and of particular relevance to the efforts of system stakeholders to enable evidence-guided policy decisions that stand to optimise health systems through improved delivery health interventions (Bosch-Capblanch et al, 2012).

## Theoretical framework

Our study responds to calls for work that improves understanding of system-level diffusion processes (rather than results; see Greenhalgh et al, 2004) – and of processes that lead to (whole) systems change, in health care settings (Finegood, 2012; Foster-Fishman et al, 2007; Edwards et al, 2011) and elsewhere (Gunderson and Hollings, 2002).

Innovation diffusion theorists (Rogers, 1995; Rogers, 2003; Greenhalgh et al, 2004), researchers interested in WSC (Behrens and Foster-Fishman, 2007; Edwards et al, 2011), systems theory proponents (Bar-Yam; 2012; Finegood, 2012), and complexity scientists (Plsek and Greenhalgh, 2001; Castellani and Hafferty, 2009; Lanham et al, 2013) highlight the importance of understanding the dynamism of complex systems in the interests of maximising the utilities of the innovation-based solutions to system problems. While they differ in their epistemologies, these literatures offer usefully complementary perspectives. Together, they afford insights into how a complex health innovation might progress – or not – from small-scale, localised diffusion to large-scale, system-wide diffusion ultimating in WSC.

## Theories of innovation diffusion

Rogers (2003) describes innovations as diffusing in an S-shaped curve, over time, through a multi-stage adoption process. Important innovation attributes – relative advantage, compatibility, simplicity, and observability – enhance communicability and uptake/adoption. In turn, the communication of these is the purview of influential individuals embedded in a social system who promote the innovation to others in the system. Diffusion and adoption is also a function of the structure of the social system in which proponents and would-be adopters are co-located. Together, all of these elements profoundly influence the extent to which an innovation is discussed, trialed and adopted (Rogers, 2003).

In their systematic review, Greenhalgh et al (2004) similarly referenced the invariable importance of social and organisational contexts to the diffusion of innovations. Within an organisational system, an innovation's adoption/assimilation is a product of its characteristics, how the innovation interdigitates with system antecedents (like system readiness for change), and how it interacts with existing (nonlinear ) assimilation and

implementation processes. Within social–organisational systems, there are individuals who may have exceptional abilities to champion both the diffusion and adoption of innovations – variously referred to as opinion leaders, change agents, or champions (Soo et al, 2009). Diffusion is affected by the skills and extent to which champions apply their energies, passion and time to promoting an innovation. Champions may influence diffusion processes well beyond their focal organisation, and may be:

> … highly influential in promoting… innovations because they are skilled at identifying problems, networking, and building coalitions… [who] possess the strength and independence to promote their ideas and create a public agenda that supports their cause…. (Nishita et al, 2007, 4).

The work of Greenhalgh et al (2004), and notable others (Argote, 1999; Miner and Mezias, 1996), further underscores the importance of outer contexts to innovation diffusion processes. The outer context consists of the sociopolitical climate, incentives and mandates, normative pressures, interorganisational networks, and environmental stability. Deep knowledge of the outer context is employed by change agents or champions to effect innovation diffusion across a system.

Several post-linear diffusion models have been proposed that offer additional insights into social behaviours relating to new knowledge and innovation (Best and Holmes, 2010; Best et al, 2009; Harrison and Kimani, 2009; Lukas et al, 2007). This work is relevant to larger social systems comprised of numerous subsystems, or multiple organisations. Denis et al (2002) usefully extend Rogers' (2003) discussion of innovation characteristics to describe the 'negotiable' boundaries of innovations, suggesting that innovations that diffuse within complex systems are frequently, dynamically, and necessarily altered over time in order to fit with the diverse and evolving interests, needs, and perspectives of various stakeholders/adopters. Here, the adoption processes are depicted as dynamic, iterative and 'cumulative and [potentially] costly with risks and benefits evolving over time' (Denis et al, 2002, 70).

### Systems theory

For the past few decades, Bar-Yam and colleagues (2012) and others (Hawe et al, 2004; Shiell et al, 2008) have advocated the use of systems thinking to address complex societal problems, including those that arise in health care. Cautioning against reductionist approaches to problem-solving, Finegood (2012) points to the need to embrace complexity and to respond to complex problems with complex solutions. Since the problems of complex systems tend to be problems relating to suboptimal interdependencies (Lanham et al, 2013) 'between individuals, organisations, or levels in the system' (Finegood, 2012, 125), solutions should target improvements to *process,* over outcomes. Further, in environments in which problems are approached collaboratively, and knowledge relating to the identification and resolution of systems problems, or failures, is cogenerated, stronger interdependencies are forged, which are more likely to lead to positive systems change (Finegood, 2012; Best et al, 2009; Best and Holmes, 2010).

## Complexity science

Complexity science offers further insights into the challenges associated with understanding complex system dynamics (Castellani and Hafferty, 2009) and complex adaptive systems (Paina and Peters, 2012). In their recent article introducing the potential of complexity science for understanding failed efforts at sustainability and spread, Lanham et al (2013) refer to the importance of understanding the interdependencies of system parts to enhancing spread and sustainability (of an intervention) across a system(s). Similarly, Paina and Peters (2012) refer to the value of work on complex adaptive systems to understanding health services scale-up failures, and to informing future scale-up efforts. Like Finegood (2012), Lanham and colleagues discuss the importance of building capacity, however here they refer to the role of social construction and sensemaking in efforts to make positive change in complex systems. There is a relationship between sensemaking and subsystem interdependencies, where:

> interdependencies that are trusting, attentive to new ideas, and mindful of differences between ideas are more likely to result in effective sensemaking [i.e., appropriate solutions] than interdependencies that lack these qualities. (Lanham et al, 2013, 3)

Two key features of complexity science that distinguish it from systems theory are the concepts of self-organisation and emergence (along with autopoiesis, system dynamics, and networks which are not discussed here) (Castellani and Hafferty, 2009). *Self-organisation* refers to the process that manifests as patterns of organisation; in complex systems, precise patterns of *emergence* are inherently unpredictable and localised as they are the outcome of local variations in contexts. Both features present challenges to prescriptive spread efforts, since the same patterns of organisation are unlikely to emerge across parts of a system. Finegood (2012) contrasts strong versus weak emergence and discusses ways to support emergence through mechanisms like networks.

## Whole systems change theory

WSC theory offers yet another perspective, describing the higher-order influences of innovations that emerge in one system component and exert changes, over time, in other linked components (Pettigrew, 1990). In large complex social systems, these changes can occur passively or intentionally, can originate at any point in the system, and can take many forms. Referring to the work of socioecologists (Gunderson and Hollings, 2002), Edwards et al (2011, 4) describe WSC as 'the uneven, nested cycles of adaptation which evolve within closely coupled, complex socioecological systems over time'. Systems, then, are dynamic collections of tightly- and loosely- coupled subsystems that constantly interact, mutually inform, and co-evolve (Behrens and Foster-Fishman, 2007; DiMaggio and Powell, 1983; Scott and Meyer, 1994).

In health care, the lens of WSC is increasingly presented as an appropriate one for guiding systems change, particularly since it recognises that contemporary health systems are complex, non-recursive, dynamic, and tightly coupled to other systems that are also dynamic (deSavigny and Adam, 2009). WSC and systems thinking are

promoted by the World Health Organisation as useful approaches to transformative systems change (Foster-Fishman, Nowell and Yang, 2007; Petricca, 2011; Matheson et al, 2009).

Edwards et al (2011) identified attributes of WSC to guide future research and change management. A few of these attributes are of particular relevance to our study of whole systems change processes. First, WSC processes are nonlinear and multilevel in nature. Second, WSC engages a multitude of system actors representing different components (for example, political, health, social and community) and different levels (for example, community members, service providers, regulators). Finally, system actors may be the recipients or targets of the change, involved in assessments of the change, or may be its architects (Edwards et al, 2011).

## Methods

System-level diffusion and WSC entail protracted processes, yet there is a dearth of empirical literature on complex systems change that takes a historical or 'long' view. This is a longstanding criticism of work on complex systems change (Pettigrew, 1990), that motivated our pursuit of case studies that afforded insights into the longitudinal/ historical aspects and influencers of diffusion and change.

Further, we elected to examine three contrasting case studies that focused on service delivery innovations which addressed different issues in different health care systems. In concurrence with Pettigrew, we felt that examination of these complex 'solutions' warranted a complex approach; while complexity science, systems thinking, innovation diffusion theory, knowledge translation and organisational learning theory originate with different disciplines, we were interested in how these theories could be used in a complementary way to inform our work.

### A priori conceptualisation and bracketing

The concepts we discuss above contributed to our a priori conceptualisation of system-level innovation diffusion, and of factors that were likely influential in diffusion processes over time (illustrated in Figure A1, see Additional File 1[1]). From that point, before proceeding to case selection and data collection and analysis, we 'bracketed' our preconceptualisations (Creswell, 2012). Bracketing enabled us to be open to observing new emergent phenomena relating to the processes, contexts and historical circumstances particular to system-level diffusion that led to whole systems change – while the literature that we relied upon to develop our a priori conceptualisation generally focused upon more homogeneous systems (noted by Paina and Peters, 2012) and on the narrow, episodic instances of change decried by Pettigrew (1990). Bracketing supported us in getting to the complexity, and messiness, of diffusion and change within systems comprised of multiple subsystems or components, where the system was in a way *defined* by wherever the innovation diffusion occurred.

### Design

We employed a multiple case study approach – appropriate for studying complex adaptive processes that are influenced by the contexts in which they occur. Further, our multiple case study design facilitates the identification of patterns across our

three cases (Yin, 2009). In our study, each case is an ENSDI which has transcended the boundaries of the social system in which it originated to diffuse to a broader systems level.

## Case selection

Cases were identified through consultation with our diverse, pan–Canadian team of co–investigators engaged in the larger programme of study. A short list of candidate cases met three eligibility criteria: (1) diffusion beyond the originating level; (2) likely to afford insights relevant to clinical nursing practice; and (3) still currently in use in Canada. Each ENSDI targeted a different health population and originated in different health care sectors. Our cases also differed in terms of their geographic/political boundaries. Each case is described in the Text Box below.

**Early Postpartum Discharge**. Early postpartum discharge (EPD) initiatives were not formally introduced in hospitals in Canada until the post baby boom era of the 1970s. The first EPD initiatives arose at the unit level in hospitals. Initially, there was little consistency among EPD initiatives across hospitals, and no evidence of inter-organizational diffusion: initiatives were esoteric to hospitals and varied in terms of the length of time new mothers stayed in hospital prior to discharge to the community, they varied in terms of the criteria for early discharge, and they varied in terms of the in-hospital preparation offered to mothers prior to discharge. While not a formal component of EPD initiatives, we also note that at this time the level of community support for newly discharged mothers and infants varied considerably by community. Over the 1980s and 1990s, cost reduction concerns and cost containment pressures escalated in the Canadian health care system. In the acute care sector these pressures contributed to increased momentum for early postpartum discharge initiatives. Over the same interval, parents were increasingly eager to "de-medicalize" childbirth and to leave the sterile hospital environments as soon as medically permissible. The de-medicalization of childbirth was a North American movement that gained momentum and led to increased consumer demand for reduced hospital stays for postpartum women; average hospital stays for mothers and their newborns shortened considerably over the 1970s through to the 1990s. EPD initiatives began to enjoy inter-organizational diffusion. Over this same interval, concern arose on the part of consumers for the comfort of mothers and families discharged into their homes, and some of the consequences of early discharge, positive and negative, came into question. From the mid-1980's, there was a call for empirical research that addressed these concerns, and a heightened awareness of the impacts of changes being effected in the acute care sector on the home and community care sector. These research efforts focused on various aspects of early discharge including the health of infants discharged early from hospital (see Brooten et al., 1986), the extensiveness of follow up services provided mothers and their infants following discharge (see Edwards et al., 1992), the efficacy of alternative community follow up programs (Edwards et al., 1997), and rates of breastfeeding and self-efficacy among mothers after early discharge (see Sheehan et al., 2001; O'Connor et al., 2003). In the Province of Ontario, implementation guidelines for post-partum programs were put into effect in 1999, marking a first effort to standardize program practices within the geopolitical Provincial system. The guidelines referred to program elements that were cross-sectoral, and had implications for different sub-systems. Ostensibly, the guidelines reflected the research relating to the intended and unintended consequences of EPD initiatives that had been completed at the time and were intended to ensure that a continuum of care, replete with appropriate follow-ups and maternal and child supports, was in place in the community following early discharge from hospital. Despite the use of evidence to generate guidelines for EPD initiatives, the official Ontario government position on EPD since 2000 refers to EPD initiatives as the outcome of maternal preference - and not an evidence-based recommendation. In Ontario today, healthy mothers and infants are discharged between 24 and 48 hours after delivery, or earlier if desired by the mother. A public health nurse is mandated to visit the family's home and provide support on infant care, breastfeeding and to offer further services or assistance as they deem necessary.

**Minimal Restraint Use.** Restraints have long been used to protect patients from self harm and to increase the safety of care providers and others by managing and controlling the behaviour of patients. As such, both chemical and mechanical restraints have been used mostly on psychiatric patients, the elderly with dementia, or others with potentially harmful behaviours that were deemed uncontrollable. Research that began to emerge in the early 1970s in the US and Canada provided clear evidence that the use of restraints could be harmful, or even fatal. In the Province of Ontario, the early 1970s socio-political movement in health care towards greater individual autonomy and more humane care contributed to a re-alignment of power bases, and promoted searches for more positive alternatives to restraints. Despite the availability of evidence and the profound shifts in philosophies of care, the movement's momentum (away from the use of restraints) was slow until the early 2000's. Prior to this, diffusion occurred largely at the unit level, where a few health care institutions had formal restraints policies in place. In part, momentum was retarded due to resistance on the part of some care providers to dispense with the use of restraints, as they sustained their beliefs that restraints kept patients safe who might otherwise come harm, or inflict self-harm. In 2001, legislation (Bill 85) was passed in the Province of Ontario for the minimal use of restraints. This change in legislation was championed by a provincial member of parliament, Frances Lankin, who put forward a private member's bill as a direct consequence of her mother's care experiences in an Ontario long term care home. Regulations were subsequently written that effected essentially instantaneous system-level diffusion of the principles of MRU within the entire Province.

**Needle Exchange Programs/Harm Reduction Programs**. Canada's Drug Strategy, "Action on Drug Abuse", was introduced in 1987; its aim was to reduce drug-related harm through enforcement, treatment and prevention programming (Cavalieri & Riley, 2012). The first needle exchange programs (NEPs) were established in 1989 in three cities in Canada: Vancouver, Toronto, and Montreal. Although established within months of one another, they varied substantially in terms of services provided, modes of delivery, and target populations. These programs started within one year of the introduction of the Drug Strategy, however they were motivated largely in response to localized concerns in these jurisdictions, that had escalated from the early 1980's, relating to the spread of HIV and Hepatitis C infections occurring through injection drug use. The Canadian Centre on Substance Abuse, established in 1990, was undeniably a direct outcome of the Drug Strategy and signaled to proponents of NEPs another positive shift in momentum for these initiatives, suggesting greater momentum toward system-level diffusion. With the closure of the Centre in 1996, and the formal discontinuation of the Canadian Drug Strategy in 1997, however, halted further diffusion of NEPs. Since 1997, no federal initiatives have facilitated efforts to treat and prevent drug abuse. Most NEPs are now subsumed by localized harm reduction programs as the latter are better tolerated/perceived by the public: despite their extensive history, and extensive research over the past decade that has demonstrated their potential to prevent or reduce harm, harm reduction approaches that include NEP components continue to be controversial because injection drug use is not legal. These initiatives contradict the purported prohibitionist stance of the current Controlled Drugs and Substances Act (Cavalieri & Riley, 2012). While the original three NEPs served as exemplars for other Canadian communities that established exchange programs of their own, all of those that remain in operation in Canada are sustained through provincial funding sources and local action including that through community agencies, educational institutions, and city councils. The lack of (support for) a national standard of service delivery has contributed to divergence among NEPs; some researchers refer to four different "models" of NEPs that exist across Canada (Cavalieri & Riley, 2012). At best, this suggests that discrete programs have achieved only sub-system diffusion, within the geopolitical boundaries of Canadian provinces.

### Ethics approval

Prior to initiating our study, the study protocol was approved by the University of Ottawa's Ethics Review Board, and the University of Toronto's Ethics Review Board, in Spring 2009.

### Sampling and recruitment

Initially we sampled purposefully, identifying individuals known to us – or referred to in the documents we reviewed (see below) – as having been directly involved in the development and implementation of each ENSDI. These individuals included researchers; administrators; direct care providers; policy analysts/decision makers; representatives of public advocacy groups; and representatives from discipline-, population- or disease-specific associations. Subsequent theoretical sampling was undertaken as concepts began to emerge from our analysis of the data derived from our initial sample (Drauker et al, 2007); from that point we identified key informants suggested through snowball sampling who varied dimensionally according to their roles/sectors, and levels in the system suggested as important in our review of extant research on innovation diffusion and whole systems change. Refer to Table 1 below for key informant characteristics along these dimensions.

**Table 1: Characteristics of ENSDI key informants (N=19)**

| ENSDM Key informant groups | | | |
|---|---|---|---|
| Descriptor | Early postpartum discharge (n=7) | Minimal restraint use (n=7) | Needle exchange programs (n=5) |
| Role/sector | | | |
| Research or academic | 6 | 3 | 2 |
| Direct patient care | 5 | 3 | 2 |
| Administrator | 2 | 4 | 2 |
| Policy | 1 | 1 | 2 |
| Guideline development | 1 | 0 | 1 |
| Level of involvement in the system | | | |
| Micro | 1 | 3 | 2 |
| Meso | 6 | 6 | 3 |
| Macro | 1 | 1 | 2 |

Key informants were invited by telephone or email to participate in the study. A brief summary of the focal ENSDI (to provide an initial point of discussion), interview questions, and a consent form were emailed to those agreeing to participate.

### Qualitative data collection

One-hour semi-structured interviews were conducted by telephone, and involved one or two members of the project team. Interviewees were first asked to reflect upon the accuracy and adequacy of the ENSDI summary. Interview questions led participants to: (1) relate their experiences with, and identify key stages of, the development

and implementation of the ENSDI; (2) identify key/critical success factors for the diffusion of the ENSDI; (3) identify barriers to development and implementation, and strategies used to address them; and (4) offer general 'lessons learned' to future ENSDI stakeholders. At the conclusion of the interview, participants were asked to recommend other interviewees, and documents for review.

### Data analysis

### Document analysis

Document analysis involved the review of public documents (for example, position papers, programme evaluation reports) and ENSDI-originating organisations (for example, implementation plans, evaluation reports, policies and procedures). Documents reviewed early in the study were used to develop the brief summaries supplied to interviewees prior to their interviews. Additional documents recommended to us by our key informants as relevant to the ENSDI of interest were also reviewed, compared to the qualitative interview data, used to develop key informant feedback materials, and incorporated into our data analysis.

### Qualitative data analysis

Audiotapes were transcribed verbatim. The project co-leads (Whitney Berta and Tazim Virani), one team member (Margo Rowan), and the research assistant (Hannah Shamji), developed the initial coding categories, based upon their review of the first few transcripts. An open coding strategy was used that involved identifying, naming, categorising and describing phenomena found in the text using line-by-line coding. The nascent coding scheme and the transcripts were then discussed by all project team members and Hannah Shamji. From that point, data analysis was iterative, and engaged all project team members. The coding scheme was used to code transcript data line-by-line; each transcript was coded independently by at least one project team member and Hannah Shamji. This was followed by a fulsome discussion among all coders and Hannah Shamji of bundles of (generally, two or three) transcripts. This approach was applied to all 19 transcripts, and was helpful in early stages of analysis to evolving the coding scheme and identifying the associated key themes and sub-themes. In later stages of data analysis, the approach was important to ensure integrity in applying the coding scheme. There were a few instances where sub-themes did not apply to one of the three cases; these were noted in the conduct of our analysis and are related in the Results and Discussion sections below.

### Key informant feedback

A timeline for each ENSDI was prepared based upon our document analysis and events within the diffusion trajectory highlighted by our interviewees. These were sent to interviewees who were asked to verify their accuracy.

# Results

## *Participant characteristics*

All case study groups included respondents (NEP=5; EPD=7; MRU=7) from research or academia, direct patient care, administration, policy decision making, and guideline development. Respondents' involvement in ENSDI diffusion ranged from the micro level, such as a hospital or long-term care facility, to the macro level, representing provincial or federal agencies or organisations.

## *Key themes*

Figure 1 is a thematic map that summarises the key themes identified through our analysis – *system readiness*, *system capacity* and *system alignment* – and related sub-themes. Key themes were present across all three cases, and sub-themes occurred across at least two of three cases. Key themes are distinct, but related, and vary together over time. We follow a letter–number convention when citing data, where the case acronym (for example, MRU, EPD or NEPs) is followed by the unique number assigned to each interviewee to maintain anonymity, for example, 'Int3' for Interviewee 3.

### *System readiness*

System readiness refers to the overall readiness or receptivity of a system for change. Levels of readiness varied across components or subsystems, and changed over time. In the case of EPD and MRU, readiness increased with increasing system alignment.

**Figure 1: Thematic Map**
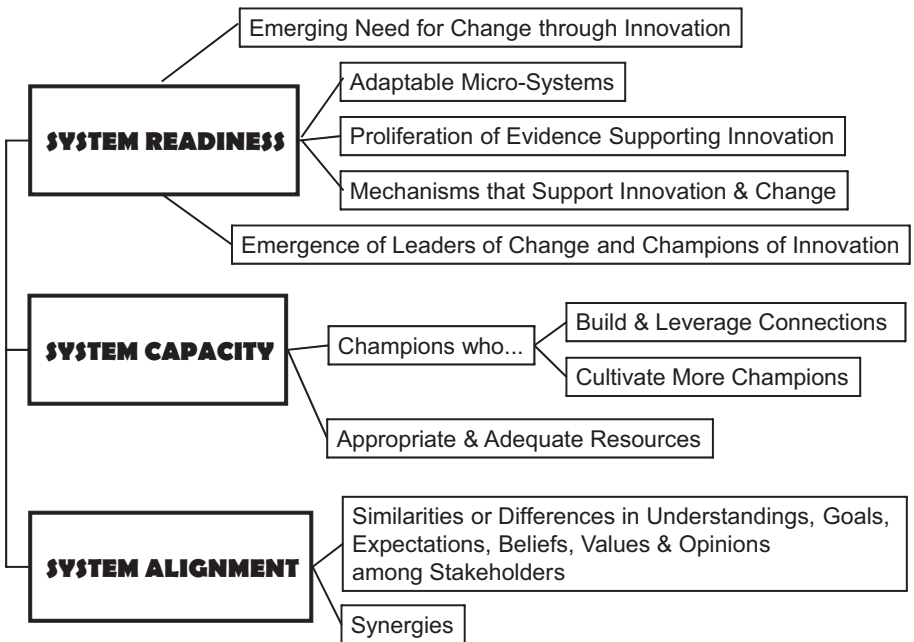
In the case of NEP, unreconciled system misalignment served to erode readiness for change over time.

One hallmark feature (sub-theme) of system readiness was *an emerging need for change that could be addressed via an innovation*/ENSDI. In general, this arose as a consequence of changing societal values and philosophies of care – we note that this feature was detectable because of the longitudinal/historical nature of our multiple case study. Change was variously championed by clients/patients (for example, EPD), by care providers (for example, NEPs), or both (for example, MRU initiative). Specifically, EPD met the needs of families that increasingly wanted de-medicalised childbirth experiences.

For the MRU initiative, the need to reduce injuries associated with restraint use was part of a movement for more humane care. For NEPs, there was a need for harm reduction practices that could bring benefits to both drug users and to society at large. Over time, additional needs for change that were addressable by these ENSDIs arose across other components in the system, serving to enhance uptake and diffusion. Despite growing momentum for de-medicalising childbirth, in the late 1980s, hospitals were confronted with intense pressure to reduce their lengths of stay. EPD initiatives, then, met both the demands of increasingly vocal health care consumers, and the fiscal imperatives of public funders of health care. For MRU, meeting legislative requirements was important, as well as accommodating the needs of health care teams, and fitting programmes to the community context in order to best serve the patient population. Initially, NEPs were introduced locally and reflected the specific needs of the populations served. A national drug strategy in the late 1980s appeared to signal political and societal support for these initiatives. Subsequently, the emergent need to situate these programmes societally and philosophically led to the merger of NEPs with comprehensive harm reduction programmes. Public concerns over increasing HIV and Hepatitis C infection rates further legitimated harm reduction approaches in the public health sector. However, in the case of NEPs and harm reduction programmes, momentum for diffusion waned with the discontinuation of the drug strategy in the late 1990s and with continued public debate over the desirability and implications of introducing harm reduction programmes (refer to Text Box). So where there appeared to be momentum for system-level diffusion of harm reduction programmes (and NEPs) up to the late 1990s, an increased misalignment among system components has served to stall diffusion at the subsystem level: at local levels, within several municipalities and provinces, where drug use is a generally acknowledged and persistent concern, harm reduction services have been sustained (see Cavalierri and Riley, 2012).

Readiness for change at the microsystem level was an important accompaniment to emerging societal needs for change. *Adaptable microsystems*, like hospitals or other health services organisations and units, provided 'experimental space' in which ENSDIs could be introduced, and trialed for their efficacy in addressing the identified need or problem.

> … the best practice movement gave great credibility and that credibility you needed to leverage… we [hospital] have a policy now that is called 'in evidence'. You cannot create a new policy or procedure without the evidence behind it, and there's a whole script of how you go about doing that. (MRU, Int5)

Adaptive microsystems were nested within larger systems. While the quote above refers to a hospital system within a larger health care system in which the best practice 'movement' took place, the quote below speaks to the influence that the larger societal 'consumer movement' had on the nested health care system:

> … I think the original impetus for short stay has to do with that whole 1960s/1970s normalisation, reclamation of birth, de-medicalisation,… but it also has to do with the establishment of the whole consumer movement… not just around labour and birth but around everything… (EPD, Int2)

*The proliferation of evidence supporting the need for change and/or an innovation's efficacy* refers to the role of research and experiential evidence in system readiness. Both forms of evidence were referred to by our interviewees as figurative in the early diffusion of ENSDIs. In the case of MRU, interviewees referred to research evidence accumulated largely in the United States that precipitated relatively rapid changes to legislation in Canada and led to government funded programmes supporting the introduction of MRU initiatives. In the case of EPD, interviewees referred to the availability of research evidence from the US, however they suggested that the early motivations for introducing EPD initiatives in Canada derived from the intersection of needs on the part of public funders of health care to conserve costs, and changing societal values that preferenced the de-medicalisation of childbirth. Close to a decade *after* the introduction of the first EPD initiatives in Canada, empirical research was commissioned (see Text Box) in response to expressions of public concern over instances where the health of mothers and newborns seemed to have been negatively affected by early discharge from hospitals.

The value placed on research evidence shifted over time for NEPs also. NEPs in Canada were founded in the late 1980s – in Vancouver, Toronto, and Montreal – at a time when community concern over the spread of HIV through shared syringe use was escalating but arguably no, or only low-level, research evidence was available. As more NEPs were founded, garnered more widespread public attention, and required more resources to sustain, stakeholders demanded higher-level evidence to justify sustaining their financial support.

> At some point, clearly, there was concern on the part of the needle exchange managers as to… a lack of standardisation… and the recognition that it was going to be very important to achieve some level of standardisation in order to demonstrate [empirically] the efficacy of the programmes. (NEP, Int1)

*Mechanisms that support or facilitate change through innovation* were important to system diffusion readiness. In early stages of diffusion, all three ENSDIs were implemented and embedded into organisations' practices through local-level mechanisms that included policies, procedures, or protocols. Some of these included *processes to identify information* relating to ENSDI implementation, and *socialisation and monitoring activities* to guide and support innovations in practice. These mechanisms facilitated early changes predicated on ENSDIs, and supported the accrual of early experiences with them.

These local-level, sub-system specific mechanisms served as important precursors for system-level mechanisms that later supported higher system levels of diffusion through standardisation. For example, from the late 1980s, managers of NEPs located in large

municipalities in Ontario, Quebec and British Columbia worked together to establish policies and standards of practice around NEPs (or harm reduction programmes with an NEP component). In the case of MRU initiatives, some organisations had developed their own formal policies and procedures well before regulation was effected.

While we referred to instances where some microsystems were particularly receptive to change, others were resistant. In these situations, *regulation and enforcement* persuaded ENSDI diffusion:

> The thing that I think helped was legislation, getting it onto the corporate and nursing quality plan [and] having the senior management validate to nurses that they need time away in order to learn about restraint… we were able to say that there is a reason why we need a least restraint policy and the legislation tells us here is where an organisation needs to put some emphasis…. (MRU, Int5)

In addition, we observed instances where regulations were *complementary* in that they were not formulated with the intention of supporting an ENSDI but nonetheless afforded reinforcing or facilitating effects.

*The emergence of leaders of innovation and change*, and environments that support them, was a persistent sub-theme of system readiness. Leaders with the 'right' qualities exhibited openness and receptiveness to change, and were adept at translating evidence into practicable care-related activities:

> … leaders, to be effective, need to be system thinkers and we need to be able to think about the interrelatedness of factors that are going to influence what happens… we want to improve the system and we appreciate evidence and we are good at using evidence to benefit and to make a positive outcome. (MRU, Int1)

Leaders were important throughout the diffusion trajectories for all three ENSDIs. Early leaders contributed to momentum for change that built over time. It was important that leaders shared their vision for change early on such that others came to understand it, and had genuine opportunities for input.

### System capacity

System capacity refers to infrastructure that facilitates innovation diffusion, or dissemination efforts. Champions were a critical component of system capacity. Innovation *champions* presided at various levels within subsystems or were situated such that they linked two or more subsystems. Regardless of their placement, the activities of champions were similar in that they served to disseminate knowledge about innovations, and facilitate understanding of them – particularly among formal leadership. Champions were also acutely aware of the need to cultivate more champions:

> … you make sure that it appears on the agenda of some committee that has strength… You need to be reporting up… on to the corporate plane… we

developed on-unit monitoring tools and we have done prevalence studies for years… if possible you always send out the success rates…. (MRU, Int5)

*Building and leveraging connections* was identified as a critical activity relating to system capacity. This involved the intentional pursuit and leveraging of connections among champions within and outside of their subsystems. Through their ties to sources of power or powerful decision makers/leaders, and to individuals involved in the delivery of programmes, champions established connections that enhanced diffusion.

> … running parallel to our best practices is the Ontario Harm Reduction Distribution Programme and they have their own dissemination of best practices and I think that the two happened at the same point in time, roughly… but [even] with the best practices, without the OHRDP we would never have seen uptake of the equipment like we do. And I don't think for the OHRDP they would see quite the uptake without the best practices. (NEP, Int3)

Particularly effective champions were those who leveraged horizontal and vertical connections. For example, the diffusion of MRU initiatives initially occurred through leveraging horizontal connections within organisations (hospitals) and within the communities that they served. This was followed by a period when horizontal connections began to be established across hospitals. In the late 1990s the initiative was legislated throughout Ontario, largely due to the efforts of former Ontario MPP and cabinet minister Frances Lankin. With passage of the least restraint legislation, there was a greater level of vertical connection between organisational actors and Ministry regulators; between hospitals and provincial associations such as the Ontario Hospital Association (OHA); and between regulating bodies such as the College of Nurses of Ontario, and nurses in the field.

Horizontal connections were important at the microlevel among frontline providers including connections established among nurse practitioners, and physicians, and at the mesolevel among professional associations, health services organisations, and community organisations. At macrolevels, vertical connections between units in the provincial and federal government were important to diffusion. The quote below is illustrative of the importance of mesolevel connections among NEP champions and community agencies and interests; it also highlights the relationship between building connections, a facet of system capacity, and facilitating greater understanding between stakeholders – a facet of system alignment:

> … the ones that have strong programmes are generally people who see there's a role for community development around this work, beyond just the outreach to the individual. … they know their community… they work with the community organisations [and] community leaders to get them onside… to make the programme, quote, 'as palatable as possible' for their communities… [and] increase understanding and the systemic responses to the actual work. (NEP, Int5)

Connections that leveraged multidisciplinary and/or interdisciplinary working relationships were referred to by study participants as key to facilitating diffusion.

Connections perceived as most valuable were those that simultaneously engaged multiple stakeholders.

> I think the key success factor of the best practices, for changing practice, was this relationship between academics and needle exchange managers. We worked very hard to find a way to talk to each other… [and] to ensure that we were all committed to the same goal… to ensure high quality services across Ontario… I think that [consensus] was a key ingredient…. (NEP, Int3)

*Appropriate and adequate resources* in support of ENSDI implementation and champions' efforts emerged as the third critical element of system capacity. Of chief concern were human resources (for example, establishing multidisciplinary teams), the purchase of technical or medically-related equipment or supplies, funding for early implementation, and training/educational resources. Shortages of health workers were cited as perceived barriers to implementation and dissemination across all three ENSDIs.

> In the early nineties… it became evident that… the shortage of nurses was a huge problem… you have… a rather entrenched belief that patients who were restrained were safer and here you are in an unsafe environment where there may not be enough staff and… there was a reluctance to [implement the change] because of the belief that it would take more staff to have patients who were not restrained and to create an environment of minimal restraints. But… in fact the research is quite clear that that's not the case. (MRU, Int4)

Time constraints faced by nurses and health workers were cited as consequential to ENSDI implementation, in particular the time needed to keep abreast of changes in best practices and to respond appropriately at the microsystem level. Educational resources were also referred to as generally lacking; educators were important to conveying basic information about ENSDI implementation and implications, and to equipping system actors with the skills to 'unlearn' pre-existing service delivery routines. It was felt that the amount and types of education required to implement service innovations were generally not well understood. Finally, the powerful professional cultures that care providers confronted in their work settings sometimes served to negate or neutralise prior learning:

> … the curriculum most definitely does teach minimisation of restraints, but once they go into the [work] culture they are very quick to absorb that [culture]. Where it was demonstrated to me so dramatically was in the relationships between nurses and physicians… they're taught very collaboratively… and then they go into the clinical arena and they come back with all sorts of negative ideas about… collaboration… I found that quite shocking. (MRU, Int4)

Funding was not available for early-stage implementation of either the EPD or MRU initiatives; instead, expenses were covered from the base budgets of organisations championing the innovations. For NEPs, a defined budget was established through government programmes (provincial and federal), however, needed additional funding

was factored into the base budgets of public health units. Interviewees noted generally that making vital resources available also served the important purpose of signalling leadership's sincerity and support.

*System alignment*

System alignment exerted a powerful influence on innovation diffusion. Alignment, or misalignment, was a consequence of *similarities or differences in understandings, expectations, goals, beliefs, values, and opinions among stakeholders* engaged in various stages of ENSDI dissemination. Stakeholders varied by ENSDI, but generally included members of different health professions, managers at all levels, researchers, guideline developers, policy decision makers (government, oversight), patients, the public, and consumer advocacy groups. Differences in understanding arose, and were sustained, for a number of reasons and while these were particular to the ENSDI, they were broadly similar in nature across ENSDIs, ranging from differences in values and beliefs held by individuals…

> I think every person might feel a little differently about it… professionally… ethically… some people have no problem belting somebody into a chair and other people see someone belted into a chair and it breaks their heart… I don't think you can diminish the impact that this has on frontline care providers.... (MRU, Int3)

…to differences in understandings and beliefs arising from historical divisions within the system:

> … territoriality tops the list… surprisingly… all the time… the territoriality between hospitals and the community folks… back in the seventies, that was all very smooth… as time went on these became very separate entities… and so there was huge territoriality and nobody trusted the other side to make sure mothers were properly looked after… there were professionals who were resistors who just didn't believe in early discharge who thought that all sorts of bad things would happen…. (EPD, Int3)

In some instances, goal conflicts – across professions, or system levels – became apparent with the introduction of the ENSDI.

Differences in values and beliefs could stall the diffusion of an ENSDI. For example, lactation consultants providing services in-hospital discouraged EPD initiatives because they feared that unassisted mothers, once returned to the community, would discontinue their efforts to breastfeed. Similarly, pediatricians did not favour early efforts to accelerate discharge as they feared for infants' health.

As mentioned previously, it emerged that stakeholders valued evidence differently, and these values shifted over time. Provision of the 'right' level of evidence at the 'right' time was described as particularly difficult to anticipate and often challenging to provide. As the quote below shows, evidence afforded by randomised control trials served to 'open the door' to EPD initiatives, however the same evidence failed to offer insights and inform the policy decisions needed to establish adequate supportive services in the community.

> … if you have early discharge and your house is cold… that sort of thing has to be taken into consideration... I don't know how you get people to look around and get a broader set of rules rather than the limited ones based solely on randomised trials, which did a lot of good in the beginning… kind of opened the door to progress…. (EPD, Int1)

Stakeholders also had different expectations regarding timelines; for example, researchers responsible for generating evidence in support of some initiatives were unable to respond to demands for high quality research evidence within the timeframe desired by policy decision makers.

Alignment was susceptible to erosion over time with shifting priorities. The quote below describes the gradual misalignment that arose with respect to early NEPs in Ontario as a consequence of not replacing system champions lost to retirement or turnover.

> … the public health branch at the Ministry was instrumental in helping put together the first pilot projects… and making sure that needle exchanges appeared in the mandatory programme and guidelines… these people… retired or moved on and… the people now in public health branch… rarely consult with the NEPs, rarely communicate with them. They're not [at] all supportive of the programme. (NEP, Int3)

Simultaneously, some researchers note that a more profound strategic misalignment arose between federal and provincial/territorial governments, which led to 'regression' of associated policy and programmes (see Cavalieri and Riley, 2012) and stalled diffusion.

Misalignment resulted in discontinuity of care across all three ENSDIs. One vivid example was the government's failure to enhance community support resources with the introduction of EPD initiatives, leading to a lack of outreach and coordination of care for transfers from acute to community care settings. Misalignment, whether arising from a general lack of understanding of the needs of subsystems or from value incongruence, led to under-resourcing. For example, the implementation of least restraints initiatives was initially under-supported as it was perceived as costly on the part of facility managers who anticipated the need to hire new staff and purchase new equipment.

The actions of champions to build connections were critical to mitigating misalignment. Champions' positions in the system permitted them to identify synergies across the health care system – that is, needs expressed in system components that were potentially addressed by a singular ENSDI. Champions capitalised upon the synergies they perceived, presenting ENSDIs as 'common solutions' to a multitude of subsystem 'problems'. One interviewee who championed EPD at the mesosystem level in the 1980s made these observations relating to synergies they recognised at the time:

> … first we had the family-centered movement, we've got attention being shown to the issue at the government level… no smoking in hospitals was starting, and there was the government push for decreasing length of stay in all services. (EPD, Int5)

## Discussion

In this study, we sought to better understand the processes of system-level diffusion, and the factors that influence these processes, in order to inform future innovation dissemination efforts. Key themes and sub-themes that emerged through our analysis and are discussed in the Results section above are summarised in Figure 2.

While not intended to prescribe a process for system-level diffusion, Figure 2 prefigures a model for system-level diffusion that begins with identification of a need for change familiar to change scholars (Kotter, 1996) and manifests in WSC.

What follows is a synthetic discussion of our findings across the three cases we examined.

### *The role of champions in identifying innovations as solutions to system problems*

In the cases we examined, it was the recognition and promotion of an ENSDI as a 'common solution' to multiple problems across components that stimulated momentum for higher-order change. This finding underscores the importance that Rogers (2003) ascribed to innovation proponents/champions, and to the communicability of innovation attributes. Champions identified synergies among subsystems, commonalities of need among subsystems, and recognised the potential of the innovations we studied to resolve common problems. They promoted ENSDIs as viable systems solutions through horizontal connections that spanned subsystems, and through vertical connections within them.

**Figure 2: Summary of key themes and sub-themes**
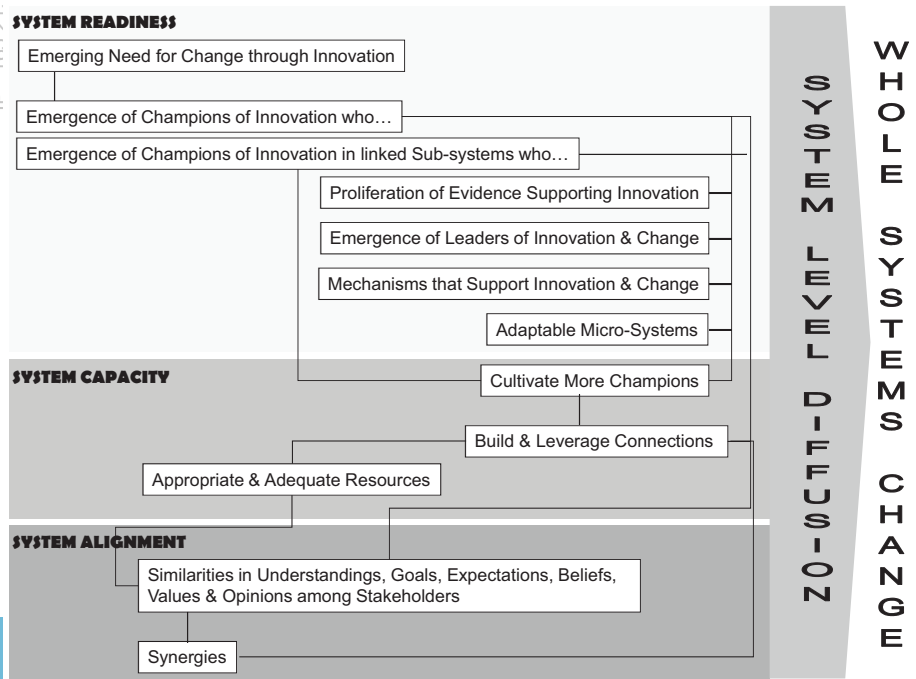
System readiness factors support and amplify the efforts of champions; these factors include accumulating supportive evidence, mechanisms that formally support innovation–driven change, and actions taken by other champions. Champions are adept at leveraging these factors, and are discussed in other work (see Lanham et al, 2013) as being critical to improving interdependencies across system components and to facilitating sensemaking (Weick, 1993), which can lead to better system alignment.

In all three cases, formal and informal champions that played key roles in ENSDI diffusion emerged without a specific recruitment effort, and identified and engaged others who later became champions themselves. Future dissemination processes might therefore be facilitated through concerted efforts to identify and support champions (Ploeg et al, 2010). Further, our findings reinforce the importance placed by others on identifying and engaging key stakeholders – and the champions to do so – in every aspect of intervention development including conceptualisation, evaluation, and knowledge translation (deSavigny and Adam, 2009).

### The varying role of evidence in system-level diffusion

While evidence played a role in the diffusion of each of the ENSDIs we studied, the role varied across cases, and across time. Evidence served different purposes, at different times, and different types of evidence were valued unevenly by a variety of stakeholders. Forms of evidence ranged from empirical research to sometimes quite limited application experience. Research evidence did not necessarily precede innovation diffusion; evidently, health service delivery innovations can emerge, evolve, and diffuse in a system in the presence of very little formal research evidence. Rogers (2003) noted this in his studies of diffusion. This was generally the situation observed in the cases of the EPD and NEP initiatives (although, evidence that supported EPDs *was* available at the time EPD initiatives were introduced in Canada – it simply did not factor into efforts to promote EPD initiatives). The role of evidence in the case of MRU differed yet again; compelling research evidence from the US was available at the time that momentum was gaining for greater individual autonomy and humane care; this evidence was a factor in propelling MRU diffusion to the system-level. In general, our findings suggest that in order to optimise dissemination planning efforts and purposeful WSC, it is important to understand how evidence is valued among various stakeholders, their perceptions around the substitutability (if) of different forms of evidence, and when – over the diffusion trajectory – evidence is likely to compel stakeholders to promote change.

### Dynamism

In our study, we observed dynamism in a number of respects. First, in two of three ENSDIs – NEP and EPD – the innovation was altered from its original form as it diffused in a system. There was a move to standardise NEPs' practices, over time, and NEPs evolved from stand-alone programmes to components of more comprehensive harm reduction programmes. Early EPDs too were initially unique to each hospital setting in which they originated, however over time greater consistency was achieved across these initiatives. Both NEP and EPD cases illustrate observations made previously, across disciplines, regarding the adaptation of innovations over time (Hawe et al, 2004; Argote, 1999; Van de Ven and Johnson, 2006; Denis et al, 2002)

and nonlinear diffusion processes (see Additional File 2). In general, our findings reinforce contentions made by learning, diffusion and complexity theorists that the amenability of an innovation to adaptation, or its malleability, may be an essential feature of innovations with high system potential, and a necessary condition for system-level diffusion.

Further, in addition to the innovations, the systems to which the innovations in our cases were initially introduced were and are themselves dynamic. Boundaries generally expanded – although that for NEPs ultimately shrank. Like the population construct described by Kreiger (2012, 664), the 'space' in which an innovation exists is 'inherently dynamic and relational', and is a consequence of interactions and shifting interdependencies between 'macro and micro, populations and individuals'. There are distinctly different boundaries to consider for each ENSDI we studied, that is, political, geographic, economic, and legal (Kreiger, 2012).

## Appreciating system synergies: readiness, alignment and capacity

System alignment increases with increasing system capacity. As alignment and understanding increase, so does the likelihood that synergies with other subsystems will be identified – with the caveat that these other systems are themselves dynamic and co-evolving – leading to further system-level diffusion. Achieving alignment of the priorities and perspectives of stakeholders, including agreement on what the innovation should comprise, and the implementation aims and agenda, is described as necessary to the implementation success of complex health system interventions (deSavigny and Adam, 2009). Enhanced shared understanding, a feature of alignment, is a consequence of building connections. As we know from diffusion theory (Rogers, 2003), complexity science (see Lanham et al, 2013) and systems theory (see Finegood, 2012) and work in implementation science (Best and Holmes, 2010), connections are built by champions. Their abilities to identify and engage key stakeholders are key to effecting greater system alignment and system-level innovation diffusion.

We acknowledge, as have others (see Kothari and Wathen, 2013) that there is a positivity bias inherent in much of the systems change literature, where the expectation is that efforts to generate collaborative complex solutions to complex problems will result in implementable solutions that are superior to those they have been developed to replace. Two of our three cases ultimated in sustained positive systems change. However, while innovations may have high system potential and stand to resolve complex problems that arise in complex systems, there is a plethora of formidable challenges to their diffusion, uptake and sustainability that may lead to that potential remaining unrealised. For various reasons (for example, retirement or movement of champions, intractable value-differences amongst stakeholders, or a lack of evidence), apparent alignment may erode over time. In the case of NEP, the discontinuation of the national strategy on drug use was associated with alignment erosion.[2]

## Limitations

Our study has limitations. While we benefited from insights of key informants who had been involved from the inception of each ENSDI, these interviewees may have had recall bias. To combat it, we engaged multiple participants from different system levels who were active at different times over the three diffusion trajectories, and
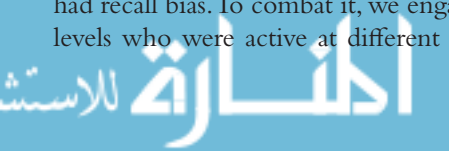
reviewed documentation to identify interviewees, and to confirm timelines and main events suggested by participants as important. Since we followed the diffusion trajectories from their inception, the advantage of our approach is that our cases were not left-censored. Second, ours was a naturalistic study containing elements of both passive and concerted diffusion, where the latter is arguably most relevant to dissemination. Finally, we did not include interviews with patients or families who might offer alternative perspectives.

### Future research

A systems approach to planning complex transformative systems change demands systems thinking ability and complex systems planning skills. What these skills are, how they are best acquired, and by whom, would be useful to know. Similarly, how best to cultivate systems-change champions, and what specific skills they need, merits exploration. Whether the skills required of systems thinkers, champions, and planners can be acquired in a manner akin to management skills training is worthy of exploration. Further, the high reliance of champions upon connections, existing and new, suggests a role for social capital (Adler and Kwon, 2002; Derose and Varda, 2009) in dissemination efforts.

While our historical case study has afforded useful and novel insights into systems diffusion and WSC, prospective studies of WSC are needed, where the trajectories of innovations with high system diffusion potential are observed in real time and over an extended time period.

The profound influence of historical and political contexts that we were able to observe have implications for future research, and for its funding; these influences would not be apparent were one to focus on short-term, left- or right-censored case studies. In this sense, the innovation uptake processes relating to the three case studies that we focus on here continue to unfold. The implications of the Supreme Court ruling, for example, which occurred after we completed our data collection for this study, will continue to shape NEPs, not only in a very direct way in Vancouver, but also indirectly in terms of what legislative norms have been set, what other provinces may choose to do and how professionals and society at large think about NEPs.

## Conclusions

Our findings contribute to understanding of the processes and factors that influence system-level diffusion of complex health care delivery innovations with 'high systems potential' to effect WSC. There are several practical implications to be drawn from our work. First, alignment matters – profoundly – and is the purview of champions who can discern important intersections of interests, and needs, across subsystems. Alignment is susceptible to erosion, and therefore requires consistent attention of champions throughout the change process. Second, complex problems demand complex solutions, and complex approaches to implementing them. This places importance on activities like subsystems analysis, the application of appropriate systems-analytic tools, and building 'systems thinking capacity', including the ability to formulate coherent cross-cutting policy and associated incentives. Finally, our reference to the importance of monitoring the influence of innovation dissemination efforts over time is not trivial. Complex change, and the realisation of the full implications of

effecting a change, can take time – and patience, as some changes are characterised by periods of incremental or no change punctuated by episodic bursts of rapid change. This observation has implications for planners of complex change efforts.

## Notes

[1] The framework depicted in Figure A1/Additional File 1 represented our expectations (and biases) of how system-level diffusion processes might unfold – and whole systems change occur – based upon our literature review, and our collective knowledge and experiences with innovation and change at a time prior to embarking upon case selection, and data collection and analysis. We did not seek to operationalise the framework depicted in the Figure. Note that the Figure is heavily influenced by diffusion theory and work on whole systems change because those were the literatures that we felt likely to be applicable to our study of system-level diffusion processes at the time we began our this work.

[2] By way of an epilogue, a very recent rigorous evaluation of the safe injections sites in Vancouver that use NEP protocols was undertaken and a Supreme Court decision was made to keep these safe injection sites open.

## Competing interests

The authors declare that they have no competing interests.

## Authors' contributions

Whitney Berta, Tazim Virani, Irmajean Bajnok, Nancy Edwards, and Margo Rowan made substantial contributions to the conception and design of the study. Whitney Berta, Tazim Virani and Irmajean Bajnok acquired data and co-lead the analysis. Whitney Berta, Tazim Virani, and Margo Rowan developed the initial coding scheme that was subsequently refined by all team members. All authors contributed to the interpretation of the data. Whitney Berta drafted the manuscript; Tazim Virani, Irmajean Bajnok and Nancy Edwards offered critical comments to all draft versions of the manuscript. Margo Rowan offered critical comments to later versions of the manuscript. All authors have given final approval of the version to be published.

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