A Realist Analysis of Streaming Interventions in Emergency Departments

by

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A Thesis submitted to the Faculty of Graduate Studies of

The University of Manitoba

in partial fulfilment of the requirements of the degree of

MASTER OF SCIENCE

Department of Community Health Science

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Winnipeg

ABSTRACT

Background: Several Canadian jurisdictions have launched interventions and strategies to address the complex, multi-dimensional problem of Emergency Department (ED) crowding. Still many of the health systems struggle with long waits. Initiatives that seem to display positive results in one site/system are often unable to show similar results in another. To make sense of such patterns, I drew on a form of theory-based evaluation, Realistic Evaluation (RE). My realist analysis focused on *streaming-type* interventions such as Fast-track/Minor Treatment Areas, Intake/Rapid Assessment Zones, and diverse types of Short-Stay Units, which separate the whole care process of patients into different streams (based on acuity and service needs) to improve patient flow.

Objective- The purpose of this thesis was to identify relevant mechanisms and contextual factors to generate "middle-range theories" for streaming-based flow interventions.

Methods- This thesis used the interview data collected for a larger project, "Patient Flow and Health Systems". These interviews were conducted with 300 key stakeholders who were involved in initiatives to improve flow, in one of the ten urban/mostly-urban health regions and zones of Western Canada. I undertook a realist analysis based on participants' explanations for (perceived) success and failure. This work was grounded in the Population-Capacity-Process model, which helped to categorize factors in a meaningful way.

Findings- Essential design features of streaming-type interventions that might have led to their success included identification of a designated population (population), allocation of dedicated

space and resources (capacity), and establishment of rapid cycle time (process). These supported key mechanisms: patients wait only for services they need, variability among patients is reduced, standardized care is provided, lag time between care steps is prevented and provider attitude change promotes prompt discharge. Critical context factors that might have impacted the interventions were lack of outflow sites and the possibility of demand outstripping capacity. An important finding of this study was that failure of interventions was more commonly attributed to design flaws (in particular, lack of dedicated space) than to context factors.

Conclusion- This study helped generate "middle-range theories" which sought to explain the outcomes of diverse interventions that share a basic program theory. In this way, it was able to provide transferable lessons for stakeholders wishing to implement similar interventions elsewhere.

AKNOWLEDGEMENT

First and foremost, I would like to express my sincere gratitude to my research supervisor Dr. Sara Kreindler, for her continuous support during my MSc study and research. Without her patience, enthusiasm, and immense knowledge on this topic, this thesis would have been a difficult task to accomplish. Her guidance helped me throughout the research work and writing of this thesis. I could not have imagined having a better advisor and mentor for the study.

I would also like to thank my committee for their continued support and encouragement: Dr. Colleen Metge and Dr. Brian H. Rowe. Their insightful comments and tough queries helped with the development of this thesis work. I also offer my sincere appreciation for the learning opportunities provided by them.

Finally, I would like to thank all the team members of the study 'Patient Flow and Health System' for efficiently executing such a colossal task. Special thanks to Noah and Zaid, without whom I would have been lost in the data.

DEDICATION

This thesis is wholeheartedly dedicated to all those patients and their family members who have tolerantly waited in various Emergency Departments. It is also dedicated to all those researchers who are relentlessly trying hard to improve our health system.

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CHAPTER 1: INTRODUCTION

The Emergency Department (ED), also known as Accident & Emergency Department (A & E) or Emergency Room (ER) is a hospital room or area staffed and equipped for the reception and treatment of persons requiring immediate medical and trauma care (1). It is a medical treatment facility that is found in a hospital or other primary care center and specializes in emergency management of patients with injury, mental health and medical conditions. Ideally, it deals with patients who present without a prior appointment; either by their own means or by that of an ambulance. Emergency Departments are vital components of the health care system and patient-flow continuum. They are a setting that usually functions 24 hours a day, 7 days a week regardless of their capacity. These units are in general bound to take in patients irrespective of their timing, physical or socio-economic condition. EDs may be the last resort for cases that have been referred by primary care, or somehow were not able to reach their primary physician. Thus, any threat to EDs' functionality impairs the whole health care system and can result in poor outcomes for patients.

A concerning fact is that EDs across the world are facing challenges that stretch their capacity to meet increasing population demands. Emergency Department crowding has become a common phenomenon and has been identified as a national crisis in some countries (2), with nearly half of all EDs reporting operating at or near maximum capacity in the US alone (3). Research from a variety of high-income countries reveals that crowding is not limited to any specific health care system, rather it is an international problem prevalent in all types of health care systems, be it single payer, two-tier or private (4–7). The problem of ED crowding is widely acknowledged; however, there is no consensus on its definition (8). That makes sense because hospitals vary in many ways; urban, rural, academic, specialized, etc. Thus, a single definition may not be

suitable. Nonetheless, in general it can be said that, Emergency Department crowding occurs when the demands placed on ED surpasses the entire hospital's capacity to provide effective care in a timely manner and safe manner in the ED (9,10). It is a condition where ED function is hampered since the number of patients waiting to be seen, undergoing assessment and treatment, or waiting to be discharged, far exceeds the physical or staffing capacity of the department (11). As there is no universally accepted definition for crowding, there is no gold standard unit for its measurement. The most commonly used metrics are ED length of stay (ED LOS), rates of 'left without being seen' (LWBS), hours of ambulance diversion, hours of access block, scores such as the Emergency Department Work Index (EDWIN) score and National Emergency Department Overcrowding Scale (NEDOCS), and nationally mandated time disposition targets (e.g. Australian National Emergency Access Target (NEAT), UK 4-hour target) (12).

For more than 20 years, ED overcrowding has been a key issue in Emergency Medicine in Canada. Canadian EDs are experiencing increased visits, higher patient complexity, higher occupancy, and crowding. They seem to suffer most from this longstanding issue, as waits here are lengthier than in most other OECD countries (13). The Commonwealth Fund's survey of 2016 also identifies a similar situation (14). The crowding problem continues to increase in frequency and severity despite political and administrative attention and public awareness. This is a concern, as crowding can result in serious consequences for both patients and staff (15). Studies identify that ED crowding leads to increased patient morbidity and mortality (4,16–18), treatment delays (18,19), less adherence to treatment protocols (20) and poor quality of patient care (21–23). It is also considered as a source of frustration and job dissatisfaction for healthcare staff and could potentially decrease physician productivity (15,24). Financial losses are also linked to it due to the increase in hospital length-of-stay and accompanying costs (25–27).

Crowding also leads to hallway treatment, which affects the privacy and dignity of patients (28). Such hallway treatments further worsen patients' condition, increasing their LOS or re-admission (29) which in turn increases the odds of overcrowding in future. Crowding is like a vicious cycle, it causes increase in inpatient length of stay (IPLOS) (30), which in turn results into further access block. Due to ED crowding's association with numerous negative outcomes, it is being considered as a significant public health issue (4,31), and leading researchers and healthcare leaders have been trying to look for both short and long-term solutions.

With a view to understand the causes and develop potential solutions, a conceptual model of ED crowding was developed by Asplin et al. in 2003. This model, based on engineering principles from queuing theory, partitions ED crowding into three independent components – input, throughput, and output (32) – and is a widely accepted model that provides a structure for examining the factors that affect ED services. Corresponding to the conceptual model (*Appendix 1*) the literature supports a variety of input-throughput-output factors, where input factors are related to demand for ED services, throughput factors are related to evaluation and treatment processes in ED, and output factors are related to ED disposition (33). Some commonly studied causes include non-urgent visits and "familiar faces" as input factors, staff shortages and diagnostic/consultation delays as throughput factors, shortage of beds and inpatient boarding as output factors (18). A comprehensive list of interventions targeted towards each category can be found in the systematic review conducted by de Grood et al. in 2012 (34). An illustration of different categories of interventions can be found in *Appendix 2*. Interventions such as media campaigns or opening of walk-in clinics try to divert less urgent cases from the ED (input); initiatives such as Minor Treatment Areas and Rapid Assessment Zones (RAZ), represent efforts to expedite the assessment and treatment process in the ED (throughput); initiatives such as

Medical Assessment Units (MAU) and increases in inpatient and/or long-term care beds represent efforts to alleviate inpatient boarding (output). Other than the above-mentioned categories of interventions, there is also another category of interventions that tries to deal with system-wide influences: Interventions such as public education, provider payment schemes, incentives/pay-for-performance (P4P) models, and benchmark reporting are multifaceted in nature targeting multiple processes (input-throughput and/or output) (34). It is to be noted that sometimes it is difficult to concretely categorize flow interventions. For example, an intervention such as a Short Stay Unit (observation unit or medical admission unit) could be throughput in nature, meant to stabilize and treat patients within ED. It could be also be categorized as an output intervention, functioning as a holding place for patients prior to discharge. It could as well be indirectly affecting throughput by relieving congestion and freeing up space.

Despite wide-ranging studies on ED crowding factors for over a decade, there is still debate regarding which factors play the most important role contributing to such congestion. Most researchers state that output factors, particularly challenges with transferring ED patients into and out of the hospital, are a major concern (35–42). On the other hand, some authors report that throughput factors such as steps associated with diagnostic tests play an equal or greater role in crowding (43–46). Input factors could also play their part, as higher volumes of acutely ill patients could significantly increase ED wait times for less acute patients, given that people who are more acutely ill are prioritized to be seen first (42, 43). In most countries, the ED functions as a universal access point or acts as a ‘safety net’ for the healthcare system (48); thus input factors such as incoming patient volume are not controllable, and interventions targeting input, such as ED diversions, are not safe nor sustainable solutions. Similarly, interventions aimed towards output factors, such as increasing hospital bed base or transferring patients elsewhere, may not be

within the scope of EDs. One study found that the impact of process improvement on patient experience was far better than impact of renovation or facility expansion (49). Thus, while factors outside the ED's control play a crucial role in crowding, it is essential not to overlook those factors that are within its control.

Almost all Canadian jurisdictions have launched interventions and strategies to address the complex multidimensional health service problem of ED overcrowding. Some are published and formal, while others are less formal and have never been published. For example, Ontario launched the 'ER wait times strategy' and the former Capital Health Region in Alberta launched Emergency Service and System Capacity (ESSC) which were bundles of multiple initiatives. British Columbia initiated P4P incentives which was a system wide intervention (50). Such efforts have either failed or yielded some improvement at some sites in terms of ED waits and flow; however, in the vast majority of jurisdictions, substantial improvements either have not occurred or have not been sustained (7). Canadian hospitals, especially those in large urban centers, continue to struggle with ED waits and crowding. A recent report stated that, during their most recent ED visit, 29% of Canadians had to wait for more than 4 hours before being seen by a practitioner. This is alarming as the international average is about one-third of this figure, i.e., around 11% of patients had to wait that long for their turn (14).

Many of the interventions that have been implemented in Canadian health systems were targeted efforts that had an adequate evidence base. They were launched with optimistic expectations, but most of the health systems still struggle with long waits. The reasons for such underperformance could vary, ranging from implementation failure to incorrect identification of the causative factor. Additionally, initiatives that seem to display positive results in one site/system were unable to show similar results in other, making it difficult to identify which of these interventions

are truly effective. More specifically, each hospital has a unique "signature" (e.g., volume, acuity, bed capacity, staffing, admission proportion, etc.) and interventions to mitigate ED crowding should be individualized. Stakeholders thus find it challenging to proceed with these initiatives, as what works in one place may not work in another.

For the purpose of this thesis, I plan to draw on a form of theory-based evaluation, Realistic Evaluation (RE), which focuses on the *mechanisms* by which interventions produce *outcomes,* and on the *contexts* that allow this to happen. It states that any outcome caused by a specific mechanism is dependent upon the context in which it occurs (51); where mechanisms are changes in human reasoning and context refers to surrounding features. These elements are critical to understanding why something works in one particular context and not in others (52). According to Pawson and Tilley (1997), *mechanism* is 'something about the measure that may lead it to have a particular outcome in a given context'. It can be the decision or reasoning process or emotion that when combined with the *context* produces *the outcome*. Contexts would be 'conditions that are needed for a measure to trigger mechanisms to produce particular outcome patterns'(52). They can be specific features of participants, organizations, history, culture and/or beliefs. RE can break down the intervention into specific *context-mechanism-outcome* configurations, making it easier to understand why an intervention worked or did not work. It has the ability to explore beyond the surface of the intervention, enabling the identification of what decisions and reasoning processes are triggered by an intervention, in a given context, to produce defined outcomes (53). To our knowledge, there have not been any such realist evaluations or reviews of flow interventions.

A Realist perspective can help us make sense of why what is ostensibly the same intervention works in one setting but not another. Compared to traditional cause-effect, non-contextual methods of analysis, realist analysis is better suited for studying complex interventions. It provides a different lens for the understanding of programmes and policies. Realist technique acknowledges that people are different and are embedded in different contexts, thus programmes or policies do not necessarily work for everyone. The first step of a realist analysis is to identify the "programme theory" that underpins the intervention. A "programme theory" is a posited relationship between activities and outcomes via mechanisms: For example - Activity (A) produces Outcome (O) because it triggers Mechanism (M). Once the programme theory is articulated, we will start considering the context necessary. For instance, “What conditions are necessary for Activity (A) to trigger Mechanism (M)?" or "What conditions are necessary for Mechanism (M) to produce Outcome (O)?” Once we are able to identify the components, we can generate *Context-Mechanism-Outcome (CMO)* configurations. In a realistic evaluation, one or more CMO configurations are tested to explain the observed pattern of outcomes. In the absence of rigorously collected information on outcomes, it is not possible to conduct a full-scale realistic evaluation; however, it is still possible to use realist *analysis* to generate and refine plausible CMO configurations that can be tested in further research. As discussed later, this thesis thus uses an existing qualitative dataset that includes abundant information on potential mechanisms and contextual factors relevant to a wide variety of flow interventions, but does not include reliable data on intervention outcomes, only on participant perceptions of outcomes. This dataset does not enable a full-scale realistic evaluation but is very suitable for realist analysis.

Realist analysis begins with a programme theory that describes how the intervention(s) is expected to lead to its effects and under which conditions. This programme theory is usually based on previous research, knowledge and assumptions on how the intervention will work. Thus, we first looked for an intervention or family of interventions that were based on some explicit theory. Second, we wanted to find intervention(s) with some supportive evidence in the literature (see literature review below). The literature would help us understand the effects of the interventions and under what circumstances they function. Third, we were looking for intervention(s) that are within the ED's scope of control. This would limit the number of relevant context factors and make it more manageable to reach conclusions.

This thesis undertakes a realist analysis focused on ED-based interventions that rely on *streaming*, where streaming would mean directing different groups of patients to different processes of care. As discussed below, streaming interventions are a good candidate for realist analysis because they are based on theory (from operations research - queueing theory, also supported by the theory of swift even flow). They have enough supportive evidence in the literature to suggest that they work at least some of the time. Moreover, they are ED-based, thus limiting the contextual factors to some extent. Examples of streaming in the ED crowding context are fast track zones, "pod" or zone partitioning, RAZ areas, and/or Short Stay Units (SSUs), and Triage Liaison Physicians (TLPs) in some cases.

Several different flow interventions in the ED reflect the principle of streaming. Some apply streaming at or shortly after triage, by separating out low-acuity patients whose needs can be met quickly (fast-tracks/minor treatment areas) or medium-acuity patients who may not require a bed for most of their stay (rapid assessment zones/intake model). Other interventions stream patients after they have received full assessment and potentially some treatment; diverse types of short-

stay units (observation units, clinical decision units, etc.) separate out patients who require a longer duration of treatment so that their care does not interfere with the efficiency of care for other patients. As all these interventions are based on the principle of streaming, all will be included in this thesis. Assigning a Triage Liaison Physician (TLP) in the ED can sometimes be considered as a streaming intervention provided that the physician offers immediate care to some patients but not others along the lines of an intake model, or directs patients to different care pathways after evaluating them (54). On the other hand, the mere presence of a particular kind of provider at triage does not necessarily mean that different types of patients will receive different processes of care. Therefore, this analysis will consider TLPs a streaming intervention only where it is clear that the TLP is providing or enabling a different care process for different streams of patients; otherwise, they will be excluded.

Streaming is an organizational approach in which the whole process of care of one group of patients is separated without affecting the care of other groups (55). Operations research studies suggest that partitioning fast and slow customers can prevent customers with shorter processing times from waiting behind customers with longer processing times (e.g., the '10 items or less' aisle at grocery store check-out). This can lead to less waits for both types of customers and, with swifter flow of ‘fast’ customers, the overall pressure on services would decrease. Studies on queuing systems also support the multi-queue strategy of streaming (56). The experts repeatedly warn against merging of queues particularly if the service time from customer to customer greatly varies (57). These service time variations can be reduced if customers (or, in healthcare, patients) are grouped based on similar service characteristics: for example, patients who can be managed quickly vs. patients who may need a longer time, or have less vs. more acuity, or need admission vs. could be discharged.

Moreover, the Theory of Swift Even Flow states that the swifter and more even the flow of materials through a process, the more productive that process is (58). "More even" can also be interpreted as "with less variability." Now, if this theory is considered in the context of healthcare, ‘materials' would be ‘patients' and ‘more productive' would be 'able to serve more patients with the same amount of resources'. Patients would flow more 'swiftly' when care processes are smooth and free of waste, and more 'evenly' when there is lower variability in patient characteristics. This theory supports the potential of streaming interventions, as grouping similar patients should lead to less variability, which in turn should increase efficiency and improve flow (58).

On the other hand, a comparison between physical patient streaming and traditional patient pooling done by Saghafian et al. showed that patient streaming could be less useful due to the ‘anti-pooling effect’ (59). This is a situation where some streams with dedicated resources may go under-utilized due to lack of demand. This, in turn, will affect the other queues, where demands would surpass the available resources, causing more delays. In some cases, separation of patients and/or resources may lead to ‘carve-out' instead of streaming. Carve-out is reserving a part of capacity for a certain group whereas streaming is separating the whole care process. Carve-out is good for those who can access the carved-out space; however, it may be bad for others. It is a process through which flow of one group of patients is improved at one bottleneck at the expense of another group of patients (60). Separation of resources or patients thus needs to be conducted cautiously, as improvement of flow of a group of patients may result in unintended consequences (e.g., increased delays, adverse outcomes) of another group.

As we notice from the literature, the same principle of streaming may lead to opposing results in different situations. In one instance it demonstrated lower average wait times as less acute

patients did not fall behind in queues, whereas in other instances it increased average waits as resources got under-utilized due to separation. Amidst such contrasting theories, splitting of demand into streams to achieve operational efficiency remains a concern. An analysis informed by realist principles could provide clarity and a more granular understanding of what works, for whom and under what circumstances.

CHAPTER 2: LITERATURE REVIEW

The purpose of this review is to describe the types of streaming interventions that have been studied, to provide a narrative overview of study findings, and to see to what extent intervention mechanisms and context have already been investigated. A formal systematic review was not necessary for these purposes and is not planned.

This review focuses on interventions that stream patients *in* the ED to improve patient *throughput* or immediate *output* (27). It should be noted that many *input* interventions try to "stream away" non-urgent patients from the ED, either by providing primary-care-type services in a parallel clinic or by discouraging patients from coming to the ED for primary-care-type problems. The evidence base for such interventions is not strong (61). There are also other input interventions that may stream some patients away from the ED by providing a specific service elsewhere in the hospital or community (e.g., direct-access specialist clinics, outpatient intravenous therapy centres, etc.); these are very diverse and have not been comprehensively reviewed. ED input interventions are affected by a broad range of context factors, most of which are outside the ED's control. To ensure a manageable scope for this project, only interventions executed *in* the ED are considered; input interventions are excluded.

During my search for primary studies and reviews relevant to streaming interventions, I noticed that most articles did not use the specific term ‘streaming' and relevant interventions went by different names. Thus, my search process was iterative, whenever I discovered another name for a relevant intervention, I added it to the search. I conducted a comprehensive search in multiple databases (including PubMed, Scopus, and Web of Science), with a start date of 2000, using the terms ‘streaming', ‘crowding' and ‘Emergency Department'. The search continued in the same

databases with the same start date for literature on specific interventions. The keywords included ‘Fast track', ‘Minor Treatment Area', ‘Rapid Assessment Zone', ‘Short Stay Unit', ‘Medical Admission Unit', along with their abbreviations (FT, MTA, RAZ, etc.). As different sites identified their interventions differently, ‘snowball searching' techniques employing the reference list of relevant articles were conducted. Individual studies from the systematic reviews were also read thoroughly, just to find something more about each intervention.

2.1 Fast Track:

Fast track, “minor treatment areas (MTAs)," or "see and treat" for low acuity cases and injuries have been introduced and evaluated in EDs of many countries. Fast-tracks are an “urgent-care clinic affiliated with an emergency department where patients seeking care for nonacute conditions are triaged for medical or surgical attention” (62). The key principle of this system is that non-urgent and low acuity patients are assessed and treated in a specific geographical area within or near the ED by dedicated staff that are able to make discharge decisions, thus preventing long waits for potentially dischargeable patients (63). It is a type of streaming intervention where similar patients (in terms of acuity) are allocated to a specific work stream (64) and the remaining patients are assessed as usual in the main department (65,66). ‘Fast-track’ was first trialed in the late 80s in the USA (67). Since then subsequent studies in the USA have found that streaming processes (dedicated area and ‘fast-track’) decreased the proportion of patients leaving without being seen from 2.4% to 1.1%. (68) and were associated with cost savings (69). A simulation on fast-track, with nurses assessing and discharging patients, found that streaming could reduce patient waiting by 50% (70).

Fast track areas may be operational during peak hours (66) or throughout the day (71). Hospitals have their own rules and inclusion criteria for fast track, but in general, patients are allocated to fast track by triage nurses based on acuity and appropriateness (65,66). Patients are then assessed, treated and discharged by a team of fast-track EM or primary care doctors and/or nurse practitioners as efficiently as possible. The physical capacity and structure of FTAs vary from site to site, as does the number and type of staff. A recent review found that the available evidence on the use of general practitioners to provide non-urgent care in EDs was weak and insufficient to draw conclusions; none of the included studies reported patient wait times or length of stay (61).

An initiative such as an FTA has the potential to reduce overcrowding as it would cater to the needs of less acute cases, which may comprise more than half the patients presenting to ED (72); however, this depends on the ED "signature". In a trial carried out at an Australian teaching hospital average Wait Time was reduced by 20% for discharged patients (66). Similar results were noticed at a hospital in the Middle East where waiting times improved by 50% after the opening of FTA (65). A study in the UK that observed around 13000 patients over a span of 10 weeks found that the FTA produced significant improvement in waiting times (73), without affecting the urgent patients. A systematic review that included 13 studies found moderately strong scientific evidence on the effect of fast-tracking on waiting time (74). All 6 studies in another review showed a decrease in Length of Stay (LOS range 13-74 minutes) in the Fast track category (63).

To summarize, evidence does exist in the literature to support FTAs; however, it is somewhat inconsistent. The wide range of LOS improvements may suggest impacts were different at different sites.

2.2 RAZ/Intake Model:

A Rapid Assessment Zone (RAZ), Rapid Assessment Pod (RAP), or Intake area is, in general, an existing ED space adapted for both assessment and treatment of lower- or medium-acuity patients that are more complex than typical fast-track patients. The model is based on the principle of single/one piece flow commonly found in the automotive industry (64) and its aim is to reduce the amount of waiting that occurs between multiple steps in the traditional assessment and treatment model. Patients in RAZ models are assessed, investigated and treated as soon as they arrive in the ED, avoiding waits for stretcher space. These patients are separated from the usual queue, treated and discharged in parallel to other patients instead previous sequential model (one after another); efficiency is assured through a 'vertical' approach (so called because patients are kept upright as much as possible) (75). The patients are placed in chairs instead of stretchers or acute beds and a dedicated team assesses and treats them, facilitating prompt decision-making and encouraging rapid patient turnover (76).

Intake models/RAZ have been variably described in the literature. The RAZ space can be either within or near the ED. A RAZ team typically comprised of physicians, nurses and junior doctors assesses the patients, initiates required investigations and starts treatment. These patients are later discharged home or, or in a small minority, referred to other services or an in-patient ward. The process being a team approach, multiple steps through the patient care pathway are avoided. The expert group of service providers deals with similar cases, avoiding variation in acuity of cases and service times, leading to a smoother flow of patients into and out of the department.

Evidence in favor of RAZ is sparse in the literature, with one before-after study in the USA displaying a statistically significant decrease in median LOS (75). The study also coined the term

"intake model" for RAZ. Another single facility study on a Rapid Medical Assessment team noticed a reduction in LOS, but deeper analysis revealed improvements were predominantly from the ‘fast-track’ portion of the intervention (77). Only one systematic review was found, which identified four(4) relevant studies on the impact of RAZ on ED crowding (76). The review highlighted differences in RAZ characteristics at different sites; such as variable operating hours, way of utilizing ED space, replacement of stretchers with chairs, etc. The review did state positive effects of RAZ but it warned that the strength of studies was weak.

2.3 Short Stay Unit:

There is no standard definition of a Short Stay Unit (SSU), however, but it is usually an in-hospital ward that provides short-term hospitalization or observation for selected patient groups. Patients admitted to an SSU, in general, have received an assessment upon arrival in the ED and treatments have been planned for acute symptoms (78). They are further observed, diagnosed and treated at the unit (79). SSUs are a broad category of interventions that may have distinct functions. These units have a wide variety of names, e.g., Observation Unit, Clinical Admission Unit (CAU), Clinical Decision Unit (CDU), Diagnostic and Treatment Unit (DTU), Medical Assessment Unit (MAU), etc. and may differ from each other in terms of characteristics, features, and mandates. The status of the patients also differs from unit to unit, as MAU patients are in-patients (already admitted) whereas other SSUs deal with out-patients (prior to disposition). Some EDs may have an escalating sequence of SSUs; for example, patients whose need for admission is uncertain may be kept in an Observation Unit or CDU until this becomes clear, and the minority who turn out to need admission may then be transferred to a MAU for a short inpatient stay. (This might be part of a longer sequence in which patients are first streamed

to RAZ, and some minority of RAZ patients are deemed to require transfer to the CDU.) Other EDs may have only one SSU that serves a broad purpose. Some SSUs function as separate units while others function as part of the ED (80,81); thus, a SSU could be run by hospitalists or could fall under the clinical governance of ED staff. They are usually equipped with emergency medical treatment facilities and sometimes advanced diagnostic equipment.

Some SSUs are specialized, only admitting patients with specific symptoms or conditions (82), and may offer protocol-driven care; others are multi-purpose, accepting a wide range of clinical conditions, and not necessarily using standardized protocols for treatment. At least, in theory, such units have strict admission and discharge criteria, and a maximum length of stay of 48 or 72 hours (or less, depending on the type of unit; for instance, observation units may have a maximum length of stay of 24 hours) (83).

Various mechanisms such as the provision of immediate access to diagnostic facilities, use of standardized protocols or application of strict admission criteria to reduce patient variability may streamline patient care and accelerate the diagnostic or treatment process (83). According to literature, SSUs can be categorized into three types based on their primary purpose:

1. *Providing care to patients with specific conditions:*

SSUs mandated for geriatric patients were found useful for geriatric assessment and treatment of exacerbations of chronic diseases. Instead of admitting elderly patients into acute care, they could be stabilized and transferred to services elsewhere. A study found that opening of such a unit resulted in a fall in the admissions into geriatric unit by 18.5 % (84). Similar units dedicated to poisoning cases (85) and respiratory cases (82) saw ED LOS fall by 68% (from 8.5 hr. to 2.7

hr.) and 30%, respectively. For patients with acute-complex medical conditions who are likely to require admission, MAUs are designed to expedite care by in-patient specialist or other members of a multi-disciplinary team (86). These specialized units were found to be beneficial because they had the potential to reduce ED and hospital bed occupancy and help with cost saving (87).

2. *Observation of patients prior to disposition:*

Observation Units, a type of SSU, also seem to benefit the hospitals both clinically and financially, as patients are more acutely diagnosed before leaving the ED, avoiding admission or longer stay in inpatient beds (88). They are designed to prevent short-stay hospitalizations for conditions that respond to treatment quickly (e.g., alcohol intoxication, asthma, gastroenteritis/dehydration, etc.). These units observe patients for a certain period (usually a maximum of 24 hours) until they are stable and/or concrete diagnosis is reached. They have strict time frames, encouraging faster discharge of patients (89). They accommodate patients who do not need lengthy and intensive treatment, and thus could be served through a unit that has different/lower staffing compared to inpatient units.

3. *Moving patients out of the Emergency Department:*

SSU's also function as a holding unit during peak times. Patients needing blood transfusions, requiring extensive diagnostic investigations such as biopsy, endoscopy or MRI to finalize diagnosis, or waiting for social services can all be accommodated into a SSU, preventing unnecessary admission or filling of ED beds (83). Establishment of such units may encourage more rapid turnover of patients, increasing the productivity of the Emergency Department.

SSUs are thought to facilitate shorter and more effective ED stays by providing accelerated care. Patients can be stabilized in such units and discharged home, instead of occupying inpatient beds. But the advantages or disadvantages for patients treated through such an intervention is still unclear. There is also debate as to whether operating an SSU reduces ED crowding (18,90,91). A recent systematic review based on controlled trials of SSUs was unable to reach any conclusion (83). The definition of SSU used in practice is ambiguous and there is also a lack of management information. Though clear mechanisms of how SSU's improve ED crowding were not found, overall administrative structure of the unit, agreements on transfer to regular ward and access to specialist consultants were some factors identified on which success of SSU depends (78,81,90).

2.4 Triage Liaison Physician:

There is no consistent or universal guideline on the roles and responsibilities of Triage Liaison Physicians (TLPs). TLPs are generally ED physicians who replace a triage nurse or assist them at a triage station. Such roles might be taken by a consultant, a senior physician, a junior physician or even a physician assistant. TLPs usually initiate patient management, answer medical consults and manage ED administrative issues. Interventions such as TLP are applied to expedite clinical evaluation and speed up disposition of less complex cases.

Most of the studies relevant to TLPs exhibit that having a TLP at the triage station improved ED LOS and patient satisfaction (54,92,93). A systematic review conducted in 2011 on effects of TLP on ED operations concluded that TLPs resulted in decreased LOS, but it also warned that 23 of the included 28 studies were of weak quality (22). It was also highlighted in the review that

the TLP had different definitions at different sites. The operating hours also varied from site to site.

It should be noted that the literature did not suggest that the principle of streaming was central to the TLP model. The articles reviewed did not mention streaming, and it was unclear how many of the interventions might have included a streaming component. Studies only focused on the fact that a doctor is present to assist the nurse, which would expedite care.

2.5 Discussion

A wide range of quantitative studies and several systematic reviews have investigated the effects of streaming interventions on ED crowding or waiting times. This literature has yielded some evidence for the effectiveness of such interventions; however, all the studies identified were focused on determining whether interventions worked, rather than understanding what caused the intervention to work. Some studies mentioned success factors for particular types of streaming interventions, but this has not been done systematically. Most studies were single-site, and none compared the outcomes of similar interventions at different sites. Moreover, there could be potential publication bias, as during the literature search I was unable to find many studies where these interventions failed. What we found from the operations research literature is the theories on which streaming is based; however, it is still unclear as to how the posited mechanisms apply to healthcare. Streaming interventions are very diverse- patients can be streamed at different times, on different criteria, and for different purposes. There are many ways the theories may be operationalized in healthcare and we are still unclear as to which of these ways yields positive results. Theories may not necessarily work in practice, especially in the field of health care which is filled with unpredictability, hence it is necessary to understand the contextual factors or

possible reasons that could lead to success or failure of the intervention. The literature does contain information that would help us identify possible mechanism, but discussion of potential contextual influences was limited. This research thus will take the next step required to identify plausible *CMO* configurations that can explain the impacts of streaming interventions.

CHAPTER 3: MATERIALS & METHODS

The study examined, through a realist lens, the perceptions of stakeholders who were responsible for patient flow in department(s), site(s) or program(s) of one of the urban regions of Western Canada. It analyzed the reasons that stakeholders gave for the perceived success or failure of streaming-type interventions. Previous studies only evaluated whether the interventions succeeded or failed. They missed identifying the reasons that lead to such outcomes for those interventions. Thus, the objective and research question for this thesis were as follows:-

3.1 Objectives:

To identify relevant mechanisms and contextual factors and generate a 'middle-range-theory' for streaming-based flow interventions.

3.2 Research Question:

1. How and why do streaming interventions improve patient flow in the ED?
2. What conditions affect the ability of streaming interventions to achieve their desired impact?

This chapter discusses how these research questions were answered, and it has been divided into several sections addressing the choice of research design, selection of informants, data collection procedure, instrumentation and data analysis. The chapter ends with the ethics considerations for the study.

3.3 Research Design:

We used a realist analysis method to investigate the interviews as it would help us understand why an intervention works in one setting and not in another. Realist analysis is well suited for studying complex interventions similar to ones prevalent in healthcare. Thus, we did a realist analysis based on participants' explanations for (perceived) success and failure. From their descriptions we were able to identify some interventions design features and flaws that may have led to success or failure of the intervention. To avoid discrepancies and to ensure participants were discussing interventions across different sites, sites were cross compared based on the information provided by participants. This helped us reach concrete statements on which sites were able to implement successful interventions, and where they failed. The cross-comparison also ensured there were no conflicting theories on the functioning of the intervention.

3.4 Sample and Data collection:

We used the interviews collected for the project titled "Patient Flow and Health Systems," led by Sara Kreindler, as our primary source of data. The project was a qualitative study whose purpose was to develop a deep understanding of each participating region's flow strategies, underlying issues and context. The participating regions were Vancouver Coastal Health, Island Health, Fraser Health, Interior Health, Alberta Health Services (Edmonton, Calgary, and South Zones in particular), Saskatoon Health Region, Regina Qu'Appelle Health Region, and Winnipeg Health Region. The project involved a combination of interviews with 20-50 key stakeholders in each participating region, document review and non-participant observation of regional flow events.

There was a total of 300 participants across all regions and the participants were key stakeholders who have been in a position with responsibility for patient flow, and/or were involved in initiatives to improve flow. They were sampled from organizations that are part of the region and were closely affiliated. Recruitment was done through purposive sampling to ensure representation of different levels of management and different component organizations within the region. The researcher and/or research associate visited sites for a week and conducted ~60-minute interviews in-person. Where participants were unavailable, telephone interviews were conducted. The interviews were conducted in spring 2016 (Saskatoon, Regina, Vancouver), fall 2016 (Edmonton, Calgary), spring 2017 (Island, Interior, Fraser, South Zone), and winter 2018 (Winnipeg). The interviews were semi-structured, followed an interview guide (see *Appendix 3*) and covered a wide range of issues related to patient flow. The interviews were audio recorded and transcribed verbatim. Pawson & Tilley note that practitioners are often a very good source of potential theories, which can later be tested (52), and the dataset from the project has abundant information from practitioners. Their perceptions and theories helped us identify potential context factors and how they interacted with our posited mechanisms.

3.5 Data analysis:

As part of the larger research project, some preliminary analysis of the data was completed. Researchers, including myself, had gone through the transcripts to identify which interventions were mentioned by each participant. All transcripts had been reviewed independently by at least two coders, with disagreements resolved by consensus or in consultation with the principal investigator. To ensure that no data were missed I screened through the entire dataset once again to identify relevant transcripts. The total dataset of the project "Patient Flow and Health

Systems" comprised 289 transcripts and contained information on 70+ interventions spread across multiple domains (Input-throughput-output-systemwide). To keep the thesis manageable and in line with the objective, I focused only on those transcripts that were identified as containing relevant data, i.e. a total of 98 in 10 regions.

We analyzed the information on initiatives through a realist perspective, by focusing on identifying the intervention *mechanism* and key *contextua*l elements required for its operation. In preparation for the data analysis, we had developed a set of sample AMO configurations based on existing theories present in operations research and management as well as from considerations in relevant articles *(see Appendix 4).* They were A-M-O (Activity- Mechanism-Outcome) configurations instead of expected C-M-O (Context- Mechanism-Outcome) configurations because previous studies had not focused on the systematic investigation of context factors, which was one of the reasons that encouraged us to proceed with this study in the first place. Thus, the configurations were not comprehensive and lacked the contextual factors. Once the results emerged from our study, we compared them against the sample configuration to enhance our interpretations.

Potential Activity- Mechanism-Outcome (A-M-O) Configurations:

1. Separating patients based on process of care length or need for specific resources (activity) might improve patient flow (outcome) as patients not in need of these services don't have to wait behind patients who need them (mechanism).
2. Grouping and streaming similar patients based on time needed for care or condition (activity), might improve patient-flow (outcome) as variability among patients is reduced, enabling efficient use of resources (mechanism).

3. Grouping similar patients based on condition (activity) might improve patient-flow (outcome) by facilitating the provision of standardized/protocol-driven care or patient management by experts, enabling quicker recovery (mechanism).

Process of analysis

Transcripts of the interviews were available from the larger research project. Contents relevant to streaming-type interventions were then highlighted and analyzed in MS Word and MS Excel. The literature base, the Input-Throughput-Output conceptual model (27), and past theories related to streaming had enabled us to choose relevant interventions and identify likely mechanisms. To guide the identification of context factors we used the population-capacity-process (P-C-P) model, which was generated from systematic examination of reasons behind the failure of interventions meant to improve patient flow (94). The model suggested that for smooth flow, a defined *population* needs to be linked to appropriate *capacity* through an efficient *process*. Initiatives that failed to consider one or more of these elements, were ineffective. The benefit of considering this model was that it applies to all streaming interventions and had the potential to help us generate a 'middle-range-theory'.

The interview transcripts were read thoroughly for initial impressions and then content analysis was carried out. As the context factors were identified from the transcripts, they were categorized as having to do with population, capacity, or process. An "other" category was created to accommodate factors that did not fit into the P-C-P model. Implementation factors identified from the transcripts were also categorized separately, as they seemed to provide additional knowledge that would be beneficial to stakeholders.

Once consensus was reached on the contents of the transcripts and their respective categorization, second phase of analysis was initiated. The chunks of texts from the articles were paraphrased into 'BECAUSE' and 'UNLESS' statements to identify potential mechanisms and contextual factors. A total of 146 statements (extracts) were identified and codes were assigned to them. These statements, categories and codes, along with their available information (participant number, type of intervention, notes, etc.) were transferred to an MS Excel file. The transfer made it easier to steer through the codes and paraphrases. Statements were re-read, and codes were revised so that they represent the data to the maximum. Repetitive keywords were identified from the paraphrases of exclusive codes and cross-matched with other codes to check if any statement was miscoded. Once we had revised the codes to ensure their accuracy and consistency, they were clustered on relevance into overarching themes. At the end the themes were compared against the sample AMO configurations in order to the identify potential mechanisms.

3.6 Ethics:

Study participants were staff (healthcare providers and managers) who have been involved in designing and /or implementing initiatives to improve patient flow or have had responsibility for patient flow in their portfolio. It was ensured that no member of the study team who had managerial responsibilities over potential participants could see the list of actual participants, nor the raw data. Participants were not told who else had participated.

All audio recording was digital and were transferred to a password-protected computer drive soon after the interview. They were then backed up on a password-protected memory stick and deleted from the audio-recorder. The memory stick was stored in a secure environment (locked

drawer in a locked office) and recordings were transcribed as early as possible. The transcriptionist worked in a secure environment and the investigator removed any identifying information from the transcripts. Transcripts were stored with a participant number instead of participants name and the master list matching names to numbers were stored in a separate password-protected computer file.

Signed consent forms were obtained from the participants after explaining the risk and benefits of the study in details. Their involvement in the study was completely voluntary and they had the option to stop the interview or withdraw from the study if they so indicated. Findings from this study will be reported in such a way that individual respondents will not be able to be identified from the reports. Furthermore, participants will have a chance to review draft reports/articles for accuracy and protection of confidentiality before such reports/articles are released publicly.

The Research titled “Patient Flow and Health Systems” had already received clearance from the Health Research Ethics Board (HREB) of the University of Manitoba and all similar ethics boards in the other participating jurisdictions (*Appendix 8*). Our planned analysis fell within what was proposed in the original protocol submitted for ethical review, so a new ethics submission was not needed.

CHAPTER 4: RESULTS

Preliminary analysis showed that fast-track/minor treatment areas were mentioned by 9 participants in 4 regions, Rapid Assessment Zones/Intake models by 37 participants in 6 regions, and at least one type of SSU (CDU, MAU, etc.) by 52 participants in 9 regions. TLPs were mentioned by 6 participants in 3 regions; however, none of the participants discussed the streaming aspect of TLP. Either the TLP was described as working within a streaming model covered elsewhere (e.g., "waiting room care") or it was not clear that the TLP was streaming patients. Accordingly, TLPs were excluded from analysis.

Many participants were able to describe one or more interventions in detail, from their personal experience or from observing others' work. Of the 289 interviews, 91 of them included one or more extracts relevant to streaming interventions. More than half *(51)* of these extracts were quite descriptive, while others mentioned the interventions in passing.

Participants were able to identify design features of the interventions distinctively. They were able to explain the activities of each intervention, and ‘how ‘ they were functioning. Still, the ‘why’ component was often missing or unclear. When asked about reasons for the success or failure of the interventions, very few of the stakeholders were able to state the mechanisms explicitly. Based on their experience and knowledge, they were able to provide valuable insights into the interventions, but the articulation of *mechanisms* might not have been exact. However, drawing on the available information and previous knowledge on streaming, we were able to identify mechanisms that were implied. Thus, we were able to proceed with the analysis as planned.

The transcripts also provided enough information to identify design flaws and external factors that potentially lead to failure of interventions. I analyzed both of these under the heading of contextual factors, while recognizing that design flaws are not 'true' context, external to the intervention.

As described in the Methods section, the coding process was informed by realist analysis and the population-capacity-process model. Each theme was categorized according to both rubrics:

- Realist analysis: Did the participant identify a design element, a mechanism, a design flaw, an external context factor, or something else (e. g. a barrier or facilitator of implementation)?
- Population-capacity-process model: Did the theme concern designation of a particular kind of population, earmarking of dedicated capacity or establishment of a consistent and rapid process, or something else?

Each extract was also categorized based on the type of intervention (MTA, RAZ/intake model, or type of SSU). Results for all types of interventions are presented together, but findings that only apply to some type(s) will be clearly identified below.

Conceptual Distinction- ' Design elements' VS 'Mechanisms"

Design Elements are the features of the intervention that supposedly make it work. They are the activities carried out by the intervention that would potentially lead to its success. Whereas mechanisms are the inherent quality of those activities that lead to the outcome. They are the hypothetical cause or the reason that explains the outcome of those activities.

Design elements differ from mechanisms as they are more apparent or visible features of the intervention. They are the working components, whereas mechanisms are the underlying reason

that makes the intervention work. Mechanisms are not always observable, but they form the theoretical basis through which the intervention produces the outcome.

Conceptual Distinction - 'Design Flaws' VS 'Contextual Factors'

An intervention may have strong theoretical grounds for its functioning. There could be various success stories from multiple sites. But when these interventions are implemented, they may not always function as expected. The reasons for such unexpected results or failures of interventions could be multi-factorial. Realist analysis allows us to identify the context factors responsible for such failures. It helps to identify why an intervention is not functioning the way it should. But not all the perceived reasons are 'true' context factors, that is, factors in the external environment. Many of them could be 'design flaws' that lie within the scope of the intervention. By addressing those flaws, interventions could be re-structured to function appropriately. The 'true' context factors are the ones that are external to the intervention. They are not usually within the scope of the intervention and would need an environmental influence for modification.

All "design flaws" involve designing an intervention contrary to its underlying programme theory. The category of design flaws includes both intentional changes to intervention design and inappropriate or unintended uses of the intervention that occur in practice. It is to be noted that this sort of modification might be identified as a design flaw by some participants but advocated by others. For example, admission of 'long-term' patients in SSUs could be a quick fix to ED crowding at peak times; some participants might describe them as useful design features because of the temporary improvement in ED functioning. We have taken those cases into consideration and have still termed them 'design flaws', as such maneuvers are contradictory to the theoretical design of streaming intervention. Also, such features of

interventions do not help to resolve the patient flow issue, they only shift the obstacle from one location to another.

4.1 Designation of a Particular Kind of Population

An essential design feature of streaming interventions was the separation of a particular kind of population from the general ED population. This was a different population in the case of MTAs, RAZ/Intake models, and different types of SSUs. As one would expect, Fast-Tracks seemed to cater to 'less-acute' cases, RAZ/Intake models preferred a 'mid-acute' or 'unknown' population. The most variation was found among SSUs. The target population differed from site to site. It was either potential 'short-term' cases or ones needing 'specialized care'. It was also noticed that when SSUs admitted inappropriate patients or patients that were not 'short-term', it clogged the system.

Design Elements:

Identification and streaming of 'less-acute' cases: Fast-track areas and Rapid Assessment Zones provide an opportunity for less acute patients to be assessed and treated in an expedited fashion. They identify and address cases with '*quick-turnaround'* conditions or lower acuity. In the absence of such dedicated unit, low acuity cases that could be treated and discharged instead get stuck in a long queue due to prioritization of acute cases.

> *"…. So if you're a certain priority population or condition, there's fast tracks to get people in and out quickly. I can speak – I took my son, for example, he had a pretty scary fall. Diagnosed pretty much by the triage nurse. He was in an out quite quickly because they know it's quick-turnaround condition. He was in and out within that hour and a half. Same condition, different hospital: he was there for three hours and took up a bed that someone was in the waiting room waiting for. So there's some efficiency things that they are working though. And they seem to be working quite well."*

"……. So they have a rapid assessment area which they have converted one area so that they see upwards of 50% of the people that flow through there. So that concept of rapid assessment areas in the past where people were CTAS 1 – 5 and the 5 and the 5s waited until the 1s were seen. Now by doing some differential flow you can deal with people and move them in different fashions as they go forward…"

Targets and prioritizes 'mid-acute' cases: RAZ/Intake areas improve efficiency by targeting a certain type of population. They seem to consistently provide care to 'mid-acute' population, but the description of the population differed from site to site. Two participants noted that RAZ provides an opportunity to 'middle' or 'mid-acute' patients to get assessed by physicians separately. These cases usually are stranded in the ED for a long time as a lot of work up needs to be done on them before a diagnosis is reached. Such patients if removed from ED and assessed quickly in dedicated units, they would recover early and hence be discharged sooner. One also noted that, as the RAZ area has no beds, it caters to patients who can sit up in a chair and do not require any procedure.

"…P: Yeah, in terms of the population. That was a zone decision that we'd see patients sit on one end, you know could sit up in a chair by themselves when they weren't actively being assessed. And they don't have something that requires a procedure, like a suture or a fracture or something like that. That middle kind of population…"

"..And it really the idea is, is: pulling patients into a, a designated area in the, into a department that are sort of your mid-acuity patients. What we find is, is our mid-acuity patients are ones that actually tend to stay the longest. Because you're trying to figure out are they actually, you know: is that chest pain; is it cardiac or is it GI related; is it something else, right? So, those ones, well chest pain used to be in too. But something like that where you've got to figure out what really is going on: they take the most diagnostics and kind of that work up phase. So trying to sort of prioritize those patients, get them in front of a physician early and then pull them. And so minimize the time that they're actually in a treatment room"

Assessing conditions of 'unknown' severity – This element also applied to Intake Areas. Emergency Departments are filled with a wide range of patients, and some of them are difficult

to gauge at triage (usually the CTAS 3 patients). The condition of such 'unknown' type of patients could be serious, hence if they are assessed quickly it would be safer for them. Some RAZ areas are built to address this 'unknown' category of patients. Also, streaming out such patients would potentially relieve the ED of some burden and allow other patients to be seen by an ED service provider. It would prevent waits for patients who could be assessed and discharged even before the fate of those 'unknown' category of patients is determined.

> *"There's another area where people come in and they may be full out flat cardiac arrest. You're not breathing, your heart isn't beating; we need immediate resuscitation. Then there are the other groups of people that we don't know what's wrong with you. Your pain could be life-threatening or it could be food poisoning. So it was that group, the unknown, but potentially very serious that this intake model was built to address."*

Admitting patients who require a longer process of care. All participants who mentioned SSUs noted that they served patients who required a longer duration of care than the typical ED patient. However, there was no consensus on the specific type of patient SSUs should consider, and reported characteristics of patient differed from site to site, even between sites that had implemented the same type of SSU. SSUs were said to improve efficiency by removing complex and resource-intensive cases from the ED and treating them in a dedicated location. They identified cases that shouldn't be treated in the ED - the ones that would take 24-72 hours to get treated - and moved them to the units. The idea was if such patients were taken care of elsewhere, they would not block the high turnover ED beds; this would potentially improve patient flow through ED.

> *"…. to try to look at patients that stay a long time in the ED that really shouldn't be cared for in an ED and looking at where the best place for that patients would be, like GI bleeds that are stable, for example, like, they shouldn't be prepped in an ED. They should be someplace else for that. So there's at least starting to identify those populations*

*and potentially moving into a CAU or somewhere else to look after them. So that's – and then being able to get them out or admitted, right, because if they're in for 24 to 48 hours now assuming there's enough space in the CAU they can be cared for there and then either discharged or admitted for longer"***.**

"..We've developed these – just over the last few months, these CAUs, clinical assessment – ...where the GI bleeds that would spend 24 to 48 hours getting their scopes and nobody wanted to admit them because they were going to go home in just two days. So they'll take those patients. Some of the socially complex patients are admitted to the CAU. So we have recourse to CAUs. So that's good....."

SSUs differed in-terms of the patients they would admit. The targeted patients for these units could be sub-acute cases that were taken in so that physicians could get some window before reaching a decision; or they could be patients that would fall under a certain treatment protocol. They could also be cases that needed observation before being discharged elsewhere. Whatever was the category, appropriate identification of patient population was being considered a design feature that could have led to success of the streaming intervention.

"P: Yeah, the right people are going there because the CAUs always were intended for at least a portion of them to be people who we think are sub-acute from the emergency but we're not 100% sure. So we send them to the CAU. The CAU looks at them for a day or so and then ultimately makes the decision, yes, they're sub-acute so off they go to sub-acute or no, actually they are acute so they need to go an acute in-patient bed. So I think we are seeing for the most part we are seeing the right people in the CAUs."

"...P: So then they have to meet a certain RADU protocol. It has to be – they have to be admitted under [the] abdominal pain protocol or under a even a higher level of care protocol for someone who is waiting for neurosurgery down in the (place) and they can't go today, they'll be admitted under the RADU doctor under higher level of care protocol which is pretty broad (laughs)."

Patients reaching the Emergency Department are of mixed variety. Some are more severe than others, have lower CTAS scores (1/2) and often need specialized care/admission. Relocating such cases to somewhere more resource-intensive would relieve the main ED and at the same time ensure better care for those cases. Two participants explicitly stated that patient flow could be improved if a specific population is provided with extensive resources. These patients could be adequately evaluated, treated and discharged in less time. The process would improve the overall quality of care and decrease the length of stay for such patients.

> *"….the rapid access unit. That's a new model of service to support a very specific clientele, a certain type of patient with specific clinical indicators, they come in they get intensive resources from, from an Allied Health broadly speaking and physician and nursing support and they're in and they're out hopefully within 72 hours, 48 to 72 hours and they're in and out.."***)**

> *"…. Because sometimes people just need a quick med adjustment ….. So just that ability to be able to do that. As opposed to immersing everyone into the general population of the ED where they often get neglected because generally speaking ED staff don't know how to deal well with mental health patients."*

Patients that can be assessed and discharged within a predictable time-frame could be removed from ED and addressed elsewhere. This would prevent their unwanted waits and relieve the ED from some demands. Short-stay units are designed for this purpose and thus should be careful in identifying and admitting those 'short-term' patients. One participant reiterated the idea that only those patients for which SSUs were intended should be admitted to those units.

> *"…. So the ones that – what you're doing is you're asking right up front upon admission one question to that physician 72 hours or less, yes or no. They then redesign and help you put that patient in the right population space that you've designed differently for that population. So you don't get into that serious, serious, complex 48-6 kind of analysis on those 72 hour or less patients. …."*

Assessment of ‘unknown’ cases in RAZ and admission of ‘longer-process’ patients in SSU might seem to be a similar design feature, but they are quite different. The condition or needs of ‘unknown’ cases vary greatly. They might get treated and discharged within hours with minimum resources, or they might need specialized support and observation for longer duration. It is difficult to reach conclusions about these cases at triage itself, thus they need to be moved elsewhere in order prevent clogging of flow through the ED. On the other hand, patients identified as requiring a 24-72 hour stay have already had their process of care defined during triage and assessment; their needs and probable length of stay have already been predicted. Usually these are cases with multiple morbidity and would require wide range of support. These patients need to be moved to a resource intensive site, such as SSUs, as treating them in ED would limit resources for other incoming cases.

(Design Flaws)-**Admission of long-term patients in SSUs –** SSUs are intended for ‘short-term’ patients who have a predictable length of stay. They need to admit only the slow responders or complex cases keep the patient flow going. If by any chance these beds get filled by ‘long term’ cases then these high-turnover beds get blocked affecting the flow of patients through these units. The admission of such ‘long-term' cases could be for multiple reasons; they may be predicted to be short-stay but end up staying longer; or the SSUs could be tempted to accept patients who are not appropriately classified as short-stay. Two participants pointed out this design flaw and state their experiences with such units.

> *“….. But again theoretically if it's somebody who's – say somebody comes in and they're elderly and they can't look after themselves and their family's out of town for the weekend you could sort of put them in there and have social services see them, and then you find out that their family actually moved to Victoria permanently. So the older infirm patient who we're all worried about in terms of flow can easily get stuck there. …… Yeah, if*

that's the only bed left in the hospital then the temptation is put somebody who's not quite appropriate in there and we'll worry about it tomorrow. And then, right, sort of open up the gates, as you like to say."

"The one at XX in particular has great flow. It turns over 40 to 50% of its beds every day. So what we did right there is identify the right sub-set of patients with the right staffing mix and the right philosophy of care which helps us move them around. And what we didn't do at that site that our other two sites have had issues with is admitting people that clearly are going to be in hospital for longer period of time but were sub-acute and were undesirable to the internal medicine service – acute care service, so they would just put them into a bed and that would block a bed and then you've lost the ability to bring in the short stay people that you could quickly turn around …"

Similar is the case with Alternative level of care (ALC) patients. These patients have an 'unpredictable' length-of-stay; thus, their occupancy impacts the flow of general patients through the units. Participants noted that SSUs will not be able to improve patient flow if they get occupied with frail elderly, sub-acute patients, and that these units should not admit ALC patients, for whom they were not intended. Admission criteria of dedicated units should be maintained and their turnover of patients through them should be sustained, to keep the overall flow of patients smooth.

"…P: Well, like using the CAU as a holding tank for frail elderly people is wrong. Like, maybe if we have enough sub-acute care capacity they can just go straight to sub-acute care instead of going there. And they can use CAU for people waiting for a few tests who can then go home which I think is an appropriate use of an observation unit of an ER but no observation unit has ever been able to operate like that like it's always been filled with these orphaned patients that nobody will take…"

"…But yeah, we have things like that or again, just putting patients in units where they wouldn't necessarily end up before. So the rapid access unit would be an example. So a 20-bed unit, anticipated a 48-hour length of stay, but we just didn't have the beds and the patients for that, so the rapid access unit has multiple ALC patients waiting and again it's not necessarily intended for that purpose…."

Most of the participants preferred avoiding admission of long-term/geriatric patients into short-stay units as stated earlier. According to them, SSUs have a defined time-frame, and long-term patients would stay longer than the allotted time-period. Their lengthy stay would block those high turnover beds of SSUs for an indefinite period. Only one participant brought forward an unusual argument in this regard. According to the participant, high-turnover beds have an administrative time attached to them. A lot of paperwork surrounds the admission and discharge process. Thus, if a bed gets filled and vacant in short intervals, there are administrative activities that surround them that would decrease the efficiency of short-stay units. This participant suggested that sub-acute patients be admitted to those units.

> *". So every time you turn over like an admitted patient, there are lots of processes that go along with looking at all their medications, writing their orders, what are their discharge instructions? Reviewing the medications, what teaching has to happen? What is the follow-up that you're planning? And on the admission side, of course, you're doing your history and your physical and determining your diagnosis and your treatment plan, and so all of that takes time. And so to turn over beds that frequently was not best for the CAU. And so then what was observed is that the other two CAUs tended to have a practice of admitting some sub-acute patients. So in other words patients that would require likely an admission either to Geri-rehab or to a sub-acute unit etcetera and that would reduce how many times you had to turn those beds over.."*

4.2 Earmarking Dedicated Capacity

An important design feature of streaming interventions was the allocation of dedicated capacity. Fast-Track Areas, RAZ/Intake areas and SSUs were provided with space separate from the main ED. Dedicated resources, such as physicians, nurses and support staff were allocated to these units. At places where space or resources were shared, streaming interventions were often reported to have failed. It was also noted that at some sites the allocated space for streaming interventions was being misused. High turnover beds reserved for streaming interventions were being blocked with long-term cases. Such design flaws led to failure of interventions.

Availability of dedicated space- Dedicated space seems to be important for the functioning of all types of ED-based streaming intervention. Three participants from our study expressed this observation from their own experience. The dedicated space provides an opportunity for some patients to reach the physician. They get assessed and discharged in that space, which relieves the main ED from extra pressure. The dedicated space also functions as a temporary parking spot while patients are being stabilized. Thus, there is a consensus on the benefits of having a dedicated space.

> *"P: Well, and this was already underway when I started that intake area with something to say let's just create some space. …… They cleaned out a storeroom and put a few stretchers in and on busy, busy days they'd see like seventy patients through this closet… and many others too is actually building a space where they could put six or seven stretchers in and see those kind of quicker. And not that they're not sick, but they're ambulatory and walking, talking and can be fine in a chair, but they need to be seen. So that took some of that pressure off. "*

> *"… I think in principle I think this is really helping the ER to – because it's kind of a place where patients can short term stay to be stabilized to go somewhere else or to go home. So this grey zone patient you don't know and you can't park him for – I mean park him – I shouldn't say that but for a limited amount of time and sort him out, right…."*

A dedicated space allows the less acute cases to be seen by a physician through MTA or Intake Areas. Usually, when an ED is filled with patients, due to prioritization, service providers get busy with the more acute cases. No stretcher space or assessment space is available for the less acute cases to be dealt with. Due to unavailability of space, the CTAS 4 and 5 patients are left waiting in the waiting room. Having a separate area from the ED where patients can be assessed and treated, promotes the efficiency of the department. It relieves the main ED from extra burden which also promotes flow of more acute cases.

> *"Well in Emerg, we saw---I mean because it wasn't very positive the minor treatment area. So our fours and fives, <u>they tried to shuffle them through a different area,</u> and a physician would try and get them in and out quickly, even though they were the least to*

kind of reduce the backlog. And we actually saw that when the hours that we operated minor treatment, we actually saw an improved time in some of our triage three's as well. Because we got them into the department and we got the clutter out, so they were actually being seen better or quicker. We did see some of that, so that wasn't what we thought would happen really."

(Design Flaw) **Lack of dedicated space** – In congruence with the design element mentioned above, participants point out that failures of streaming interventions are associated with their lack of dedicated space. There is either a shortage of space; the area is not equipped with necessary chairs or stretchers; or the intended space is being occupied for other purposes, such as parking space. Without a dedicated space it is difficult to proceed with a streaming intervention, as the whole idea is to provide dedicated care in a separate location.

"...., Rapid Assessment Zones. Most of those where they've worked, they've had physical space to do it properly. And where they haven't worked they have not."

"Oh, the minor treatment areas, they are non-functional.
I: Tell me about why they are non-functional. What's that –
P: Because half the times they are being used as parking spaces for people who need to be admitted."

A couple of participants mentioned about a unique type of streaming units: "virtual short-stay units." At few sites, there were Medical Assessment Units (MAU) or Diagnostic and Treatment unit (DTU) where there was no geographical location for those units. An assessment team was present that would go and deal with patients in other units in an efficient way. These units were described as either not working or being of "marginal benefit."

"So now we have what's called a medical assessment team which is basically – we tried to take all the good things out of that and put it into a team that creates a virtual – so it's not a geographically located area but we have a team that goes and sees all the new admissions for medicine and tries to deal with them in the most efficient way possible. So that's an example of having an internist available 24 hours a day sort of things. So we tried the medical assessment units. It is a marginal benefit."

"So XX kind of had a virtual DTU kind of thing. It sucks. Those things don't work."

(Design flaw) **Misuse of allocated space.** To overcome capacity issues sometimes the same space is used for multiple purposes. This might seem to be an effective strategy, but it also undermines the concept of dedicated space. Some participants reported that SSUs were being used as a generic overcapacity space or extension of the Emergency Department. Its stretchers then get occupied by in-patients, or they turn into holding units when the hospital is fully. One way or the other their turnover is impacted as patients occupy these temporary beds for an indefinite period. Such misuse of space reserved for quick assessment affects the overall flow of the patient.

"The problem is that in the zone capacity trumps everything. So we cannot have empty beds on a RAU and patients waiting in the Emergency Department for a bed. So even if they're not technically appropriate for RAU, they'll sometimes be shuttled into the RAU just to free up an Emerg bed. So we've been trying to juggle that a little bit and we've carved off--- like RAU is a 20-bed unit and we've carved off five beds to act as flex beds, so we can decompress the Emergency Department. But then we lose those beds for the RAU because the whole point of the RAU, right? That's kind of sad. "

"Well, I think that those beds – I don't for sure because I wasn't working there but from hearing about it and then seeing at a little bit of a distance about it, I think it's because those beds just became like extension beds of the emergency department. So they just got filled up and they didn't actually help with the flow in the emergency department. "

" I mean we try to---the medical assessment unit here did not go well; it ended up being a holding area. So we've tried---when you asked what didn't work, we tried medical assessment unit, where you're admitted in Emerg and this was co-located with Emerg and you went right there and then you were supposed to get to the right bed the first time. Well, what happened was as everything got full, you ended up staying a medical assessment unit and getting discharged from there. It became a holding unit."

"P: Yes, so the purpose of the CAUs as I understand it is it's a SSU for anybody who isn't ED, who is obviously going to stay longer than the four to eight hours. And they are supposed to be moved to the CAU where they can be assessed where I think the goal was 36 hours.

I: How's that going? Where is it [at] now and how well is it working?
P: They're all full. I know that as far as I know none of them are within the 36 hours. The length of stay is [longer]– ")

Availability of dedicated resources – Dedicated resources here would mean dedicated physicians, nurses and support staff for the streaming units. These units could be an MTA, RAZ or SSU where the space is provided with all the necessary resources. Having such a resource-filled unit would promote efficiency as patients would be assessed and discharged without them waiting for resources that are being occupied by prioritized patients of the ED. Also, if units are provided with dedicated resources, there won't be any lag time between assessment, treatment and discharge steps.

"…So we here at this recently did some renovations to move our intake area out to the waiting room and it's given us back five stretchers within our Emergency Department. So we gained a little bit of space that way. And then we try to have a physician dedicated to that area for the first two hours of their shift. So if a physician is in one space in the Emergency Department in terms of flow its way more efficient and you have all your patients and your nurses in close proximity and your exam rooms. So those are strategies we've tried there…"

(Design Flaws)- **Shared physician.** One of the major design flaws with streaming interventions in some site was that dedicated physicians were not allocated to the streaming units. The same physicians tried to serve patients in Fast Track and the main Emergency Department. Serving both places or reassessing patients in both units decreases the efficiency of such units. The principle behind Fast Track/RAZ is that less acute cases should be separated from main ED and get assessed by physicians so that they can be discharged early and do not have to wait in queues in main ED. Now if there are no available physicians to assess them on time, it rather turns into a

slow unit. Participants pointed out that due to lack of dedicated physicians, the physician initial assessment time increases, and that rotating physicians between the main ED and RAZ slows them down as they still need to reassess their previous patients.

> *"..P: Well we put in a fast track. And, um, that's' probably and we still actually are running quasi fast track. What we're finding though is that the physicians aren't getting to it. So fast track has turned into a slow track.*
> *I: It's staffed by the same people who are also serving everywhere else?*
> *P: Yes, we have some dedicated nursing staff in there, but it's the same physicians. So they keep getting pulled into the other ones and so now fast track is really sometimes they our, they have the longest basically PIAT, physician initial assessment time. So not ideal..."*

> *"…….. The way our physician schedule is set out is that you start out in PTA for your first three hours and then move to the core for more acute patients and then you're supposed to end up with your last two hours managing those lumps, bumps and bruises easily. For a number of months PTA, they were very keen on it, but what they found out is that they were still responsible for the patients….. So I had to go back and reassess; consult; discharge; more tests; review ultrasounds; while still managing the acute patients. So I think, that way some of the, you know, I think some of the work has slowed down in PTA which didn't manage flow because of the way that it was set up…"*

One participant though did suggest that SSUs did not necessarily require dedicated staffing and might function best with a "permeable membrane" between the SSU and the main unit. Such strategy would ensure that resources are available in both the places and would make transition of patients between the units easy.

> *"…. So I guess it was a little easier to staff with the physician leadership because you have a bunch of emergency room physicians present in the larger ER anyway. So there was a little bit more of a permeable membrane in passing through when they are doing things in the DTU and when they are doing things in the rest of the floor…. And similarly a little better flow in terms of the nursing staff so when they are not dealing with the four to six bed DTU or whether you were dealing with the rest of the floor, again, just a little easier to handle that. So resourcing was easier and the operational transitions from being -- a patient being in one place to moving into this place went a little better…."*.

(Design Flaw)- **Inappropriate staffing.** At one site, a participant reported that an SSU did more harm than good: Patients were dying as the staffing was insufficient or inappropriate. It may happen that resources may be rationed, or staff may not have the required expertise, in both the cases there could be detrimental effects. Thus, units need to optimize the number as well as the expertise of support staff to keep them running. In the absence of support staff, the units cannot perform efficiently.

> *"And get them---so a medical patient rather than them having to wait on another floor, we had them wait in a different area [an SSU]. It didn't make a lot of sense, but anyway, we implemented this medical admitting unit to improve our processes and it had a very detrimental effect. You know our patients, we actually started having codes down there and we didn't really know how to staff it because we didn't know who to staff it with. So you staff it with people who have a lot of experience, but could be better used in other parts of the hospital or you could staff it with what they chose was mostly health care aides and then we ended up having critical events"*

4.3 Establishment of consistent and rapid Process

An intervention may have identified a designated population and could possess dedicated capacity to support them. But if there is no consistent process for the population to reach the capacity or vice-versa, the expected results might not be gained. From our study we identified some key design elements as well as potential design flaws in the establishment of processes for streaming interventions. Rapid cycle time, targeted discharge planning and maintenance of a strict-time frame for SSUs were some design feature that lead to success of interventions; at places where the time limit of SSUs was not maintained, the units were boarded with "bed-blockers". Duplication of procedures was also noted at some sites due to lack of monitoring.

Rapid cycle time - RAZ/Intake areas are established to speed up the care process of certain patients. These units, as the name suggests, are defined to rapidly assess patients. Several participants noted that physicians and nurses supporting these units have a clear sense that the unit is a quick assessment area, thus they act accordingly.

> *" ..So we direct those patients to Intake and the way Intake works is you have a number of stretchers which are necessary for evaluating patients, but they're used in a touchdown mode, meaning that the patients are brought in quickly and they're quickly assessed by the physician and they're taken out of the stretcher. So it's kind of a rapid cycle, quick assessment area."*

> *"And so doing this PTA we do those mid-level acuity patients: you get seen, the idea was that you get seen quicker; have tests and diagnostics initiated, initiated at an early time and ultimately, you know, have their disposition done and in no time we manage."*

> *"So some of our smaller sites, CTAS 4 and 5 would make up 50-60%. Here they don't tend to take up as much… I can flow the 4s and 5s through really quick. And the physicians are quite happy to do that, to flow them through really quick.")*

Rapid & targeted Discharge Planning – SSUs are designed to function as an intermediate step in a patient's care pathway. Patients are streamed to these units so that they can be observed and discharged without experiencing a prolonged wait in ED, or needing to occupy in-patient beds for a short time period. The separation of certain category of patients and provision of allied health support for a limited time provides an opportunity for service providers to develop targeted care plan. Patients enrolled in SSUs are provided with better solutions with case specific experts and more staff support. One participant noted that this rapid, targeted care helps with patients' timely discharge and ensures that those who would have otherwise gotten stuck in ED can proceed to their next destination**.**

"…I'm talking about your frail elderly population, right. So you get your 75, 80 year old that's had a fall, home environment, daughter's not around. Caregiver burnout comes in, well, you start testing an 80 year old, you're going to find something, right. But within 72 hours if you can actually get in there and have some home support set up and a quick with OT assessment at home to reduce the risk on the falls, the doc will, you know, sign off on the MRP – sign off on the discharge plan… So you got to – so back to your original question, yes, I do agree that don't do the complex care plan on every single person, absolutely not. But understand up front and redesign your care on when you need to and when you don't. But if you don't do that global demand analysis from your data you can't figure that out and people get lost in the system."

Having a strict time frame. Participants noted that one of the vital design elements for the success among SSUs is that there is a time frame. When units maintain their strict time frame, they encourage the necessity to discharge patients within that time frame. Some participants said that this policy promotes a mindset among providers that a patient needs to be either admitted or discharged, they cannot be here for an indefinite period. Such rules and expectations, when embedded in daily practice, promote the efficiency of a SSU.

"I: Now sometimes when people have [short-stay] units, patients just sit there, it becomes a parking lot. How was it ensured that they didn't?

P: In the DTU, you mean?

I: Yeah.

P: They did try to keep rules around, you really don't want a patient in the DTU for more than 48 hours, better yet not more than 24 hours and probably a dozen is more like right."

"P: I think the problem there is that once you are admitted the threshold to be discharged or go somewhere else [is] much higher than if you are in a SSU like CAU where the mandate is to sort you out, right, and I think there is an advantage of having a CAU …".)

"…, we changed the focus very much on those types of SSUs in terms of – you're here to be assessed and you're here for observation and we're here to make a plan and the plan is we're either going to have to admit you because you do have something that requires an admission or you don't in which case you are going home. And I think the philosophy really changes in those units."

"During the week we have a nurse practitioner who runs the department Monday to Friday and she is very good about staying on top of it. It's just sort of ingrained – and even when she is not there on the weekend it is just ingrained in our culture that the nurses and the charge nurse expects the patients to be discharged."

(Design Flaw)- **Time frame not strictly maintained.** Having a pre-defined time frame is one of the design criteria of SSUs. Participants pointed out that if this time-frame is not maintained strictly or if patients stay in the unit for extended period of time, benefits of such units cannot be reaped. If patients do not leave within the pre-established time frame, or if it gets difficult to enforce discharge criteria then SSUs would be of less help in promoting efficiency.

"It works really well. But again it's the only time I've ever seen it work. I've seen this concept many times but I've never seen it work before. .....I have seen this rapid access unit in every emergency room I've worked in and I've never seen it work because it's always just an in-patient unit where people end up staying for a ridiculous length of time.")

"The other thing is that there – it's difficult to enforce clear discharge criteria. So you can only have a CAU if you are there maximum, say, 36 hours or 48 and you're mandated to leave. That's often been something that's been a rate-limiting step."

Other Design Flaws Associated with Process

Not admitted under ED physician – SSUs are separate units where patients are streamed from the ED after initial assessment. Their resources are usually separate and may or may not be under the administrative control of the ED. One participant suggested that, unless the SSU is under the control of the Emergency Physician group, they won't be as efficient as expected. ED physicians have an ethos of wanting to discharge patients quickly, hence if they are in charge it is possible that the patient turnover might increase.

"They have one wherever else I worked but the difference is they would be admitted to either hospitalists or whoever wants to run that department, right. They are in-patents.

They are presumed to be a short stay, so they go through this rapid – and it fills. It fills up and they stay there and (place) had one in there for seven months. It was embarrassing. Here they are still admitted but they are admitted under emergency physicians….. And they are meeting that goal most of the time and 70% of those people are being discharged…… That's a brilliant program."

4.4 Mechanisms Identified

Most of the participants did not state the *mechanisms* for successful outcomes of the interventions explicitly. They only mentioned various design elements as the reasons for the success of a streaming intervention. In some cases they offered a causal explanation that strongly implied a mechanism, in others they did not. In order to recognize potential mechanisms, I compared the themes against the mechanisms I previously identified from the literature. I also noted themes that did not fit in one of the previously identified mechanisms and analyzed those to articulate additional mechanisms.

Mechanism 1 - Patients wait only for those services they need: By identifying a particular category of patient and streaming them to a different location in the ED, streaming interventions ensure that patient groups are separated based on need. This would provide equal opportunity to patients in the main ED and patients in the streamed unit to access resources as needed. None of the groups have to wait for the resources they need.

This mechanism is most relevant to the design elements/flaws in the "capacity" category. Having dedicated resources for a specific group of patients ensures that they do not have to wait in queues behind patients who need some other type of resource. Tailoring the type of capacity to the need (e.g., chairs instead of stretchers for patients who can sit upright) ensures that patients only consume the types of resources they need. If, on the other hand, resources are being shared

across streams, then the whole purpose of streaming is undermined. When patients in multiple streams are all waiting for the same resources, this is no longer streaming, but merely separate queues.

We notice for example, that the less acute patients are assessed and discharged in the designated space of a RAZ, which thus keeps these patients away from main beds. This prevents unnecessary blockage of valuable acute care beds.

> *"And last year something like 30 to 40% of all our CTAS level one to three patients flowed through the RAZ unit. You know bed blocking is a thing in Emergencies, a big issue. A huge percentage of our patient care is started there...sometimes patients never make it to back beds. We do all the work-up in that unit and then discharge them from the waiting room without them ever getting to the acute side."*

Mechanism 2 - Variability among patients is reduced, enabling efficient use of resources:

Though this mechanism was not explicitly stated by any participant, design elements such as admitting the 'right' patients and redirecting cases that need extensive resources are meant to reduce variability among cases. Some streaming interventions (MTA, RAZ) improve efficiency through their rapid-cycle, high-turnover processes; these depend on there being minimum variability among cases. Now, here the reduction in variability does not necessarily mean that patients with similar conditions are streamed to these units. The conditions of patients might be different, but their acuity would be similar. For example, the same unit might take in a wide variety of cases, such as ankle sprain, cellulitis, etc., but their CTAS scores, complexity, co-morbidities and ease of assessment are more similar.

> *".. You just work three hours straight. All the patients come through you. You tap them. You do their tests. You discharge them. And then when you finish those three hours you are replaced by another person who comes in and just drives it for three hours…… And initially we said, you know, you are asking us to see five patients an hour. That's*

ridiculous in this complex department. But it turns out that's exactly what you see. You see five an hour. Every once in a while you'll see four an hour if it's really slow. And you'll see six an hour if you've get a lot of ambulatory stuff.

Mechanism 3 - Facilitating provision of standardized care that enables quicker recovery: This mechanism was also not explicitly stated, but it was implied by participants who described the role of a designated stream in providing either protocol-based care or services to a specialized population (e.g., mental health). When the 'right' patients or patients in need of extra resources are streamed to units dedicated to them, it gives them an opportunity to receive standardized care. Dedicated resources that are specialized to deal with such patients are readily available, which facilitates a quicker recovery.

"…. Because sometimes people just need a quick med adjustment ….. So just that ability to be able to do that. As opposed to immersing everyone into the general population of the ED where they often get neglected because generally speaking ED staff don't know how to deal well with mental health patients."

Mechanism 4- Preventing lag time between multiple steps: If resources are dedicated to a particular population, it is possible to provide them with an efficient care process with no or little delay between the assessment and treatment steps. Also, when nurses and physicians work simultaneously on a group of patients, a lot of paperwork and repetitive activities can be avoided. All these activities prevent lag time between multiple care steps that encourage efficient patient flow. Traditional care models were more sequential in nature where nurses would assess patients initially and then physicians would check-in. One participant described how in a RAZ/Intake model, physicians and nurses working together prevented repetition of activities that improved overall efficiency.

"But we did it a little different in that we put a nurse with a physician and a nursing assistant together and they did their assessments together and therefore eliminated for the most part a lot of the documentation and history taking redundancies so we had them focus on patients who they perceived they could prevent from hitting a main unit bed …"

Mechanism 5 - Promoting change in Attitude: This mechanism, while not identified in the literature, was implied by some interview participants. The motive to rapidly assess and discharge patients seems to spread throughout the hospital on implementation of streaming units. Service providers in contact with such units develop the mindset to quicken the patient care process. They start promoting such efficiency in other units. Also, in RAZ/Intake areas at some sites, patients do not always change into gowns. Such acts improve efficiency by changing providers' attitude about how much care people need.

"I think the one thing we've seen because our hospitalists work in the rapid access unit where it's really good towards getting a patient out as efficiently as possible. They tend to take that mentality with them to their other patients, so you don't necessarily have the same infrastructure where they have a social worker and dedicated PT/OT and nurse practitioner. They have a whole team that's really geared there towards making that efficient discharge process, but at least that mentality of 'let's get our patients out earlier' tends to spill over, so we've seen some benefit in that respect."

"And they don't change you into a gown. Because once you're in a gown, then you think you're sick. So I mean we may put a gown on you---for example, they might put a gown on me and leave my jeans on if its abdo pain, or if it's a woman and they know you have to have---if it's abdo pain, then it would be gyn also exam. So then that's part of what we did to increase the flow in the Emergency Department."

Mechanism 6- Efficient use of available space- RAZ/Intake areas at some sites help improve patient flow as the space allocated to them is redesigned to serve more patients. Their allocated space is freed of stretchers and is instead filled with chairs. Patients in some cases, can be

assessed and treated in upright position. Thus, by better utilizing the available space and replacing stretchers with multiple chairs the total number of outputs could be increased. This increase in number of assessment and treatment spots may increase the turnover of patients. As described by participants, the space allocated to RAZ/Intake areas is re-designed so that multiple patients can wait, be assessed and even treated at the same time.

> *"..They order tests on you and blood work or whatever and then you go and sit here and have your test from here. Then we put another patient there, so no patient owns a stretcher. ……. And it allows us to take spaces that would only hold one stretcher or two and make them into five or six spaces and people would actually rather sit up than lay down and rather sit up and watch TV. So by doing that, we changed the flow of patients.."*

> *"..In Intake, you have instead of using your ten beds and that way you might have two beds that are resuscitation and three bed, five beds in pods and in that five-bed pod you would have five assessment places and you would have all the chairs that would have otherwise been in the waiting room in the same space. ….. she'd bring in the next patient and while she's assessing there, the first patient is waiting and maybe the CAT scan becomes available to the porter takes him to CAT scan, but they don't sit in the---they don't occupy the treatment space the whole time."*

> *"… what we're doing is: we're getting you to a room; having the nurse and the physician assess you; once that piece is done and there's not active care going on we pull you into an internal waiting room and we see the next patient. And then in the internal waiting room sometimes that's where you're: you're going to get your IV antibiotics, you're gonna get your, maybe it's your Ventolin or whatever it's. So a lot of that treatment is occurring in that internal waiting room while the next patient is being assessed."*

By assessing the patients in an upright position or only transiently using stretchers, RAZ/Intake areas prevent the use of stretchers among patients who do not need them. Valuable resources such as staffed stretchers are utilized to the minimum and patients are served just what they need. Patients streamed to these units do not block an assessment bed; instead they free up bed spaces for upcoming patients.

"..So patients that, like, migraines and gastros and maybe renal colics and abdo pains and chest pains for the most part...just need a chair. They don't need a stretcher. So I think the recognition that the most valuable resource we have we need to protect, that's the acute monitored stretcher. And everything else doesn't matter."

" So we've kind of rethought that concept through the Intake initiative and I guess the underlying principle is that most patients don't need to own a bed and don't need to own a stretcher. .....So we direct those patients to Intake and the way Intake works is you have a number of stretchers which are necessary for evaluating patients, but they're used in a touchdown mode, meaning that the patients are brought in quickly and they're quickly assessed by the physician and they're taken out of the stretcher."

".... – they've started to try to segregate the patient population as they come into the ED [RAZ] between those that have to become horizontal, have to have a bed to lay down on versus those that traditionally would have been given a stretcher, they would have stayed in that stretcher for the duration of their stay but really could be just use an exam location for a physical exam by the physician or clinician and then while they are waiting for test results to come back or even consultants to come potentially depending on how sick they are where they could be – where they can be kept in chairs which frees up the horizontal spaces for the next patients and it allows a better throughput."

4.5 Context Factors

Participants mentioned many factors for the failure of the interventions. However, a more in-depth analysis revealed that most of those failure factors were actually design flaws or maintenance issues, rather than true contextual factors external to the intervention. 'True' context factors that were separate from the intervention and affected its functioning are as follows; most were related to capacity issues.

Lack of outflow sites/access block- This was by far the most widely stated context factor that leads to failure of RAZ and SSUs. A streaming intervention might assess and treat the patient very efficiently, but if that patient is not discharged to another location, their LOS remains unaffected. There is no flow if there is no disposition. Obstruction to outflow was reported by multiple participants as the reason for failure of streaming interventions. Lack of outflow

hampers smooth patient transition out of SSUs, which in turn clogs the whole patient flow continuum. Patients may also get stuck in Rapid Assessment units if they start getting admitted there or if they are not discharged elsewhere.

> *"The problem in emerg is...not enough forward flow, so we [are] sitting with more than 20, sometimes up to 30 admitted patients in our department and we're running the emergency department out of the front door -- so in the rapid assessment zone which is not rapid anymore at that time -- and the waiting room. So that's our biggest problem with ED congestion".*

> *"My impression is that it's just they're bogging down, like they are not getting the outflow of the in-patients upstairs and therefore they're always over 100% capacity and therefore it just slows everything down."*

> *"So let's give you three days to sort out this patient. But then the patient should go. Should go to the next phase of care. Well, that never happens. So all these programs come and they go, doesn't meet my program. Ask him. Ask that one. Ask this one. And the patient stays. And sometimes the patient doesn't get access to the (place) because we are not the priority and then we're told, well, these patients shouldn't stay that long on the clinical assessment unit."*

Inadequate resources. RAZ or SSU's cannot promote efficiency if resources surrounding them are unavailable or insufficient. Any intervention would struggle to thrive without adequate finances. This was pointed out by participants particularly in regard to SSUs. They repeatedly stated that SSUs are expensive to maintain because of the geographical space they occupy.

> *"Exactly, like the RAU, the idea was that this was successful, it could be something that could be modeled at other sites, but I have yet to see any funding or discussion. But we know it works but it's very expensive."*

> *"I think there were things about it that were somewhat effective, but it was very expensive the way we had created and it ended up – we ended up having to give up the budget for it because I don't think we saw the benefit that we would have liked to see."*

As streaming interventions need dedicated space and dedicated physicians, they also need dedicated staff. Recruitment of sufficient support staff is not always within the scope of intervention. Amidst a shortage of support staff, physicians and nurses cannot provide services efficiently. Turnover of patients would decrease drastically if physicians or nurses were involved with housekeeping instead of focusing on patients.

> *"I think fast tracks have lots of value but you also have to have the staff to do it. The other piece that we're running into is PTA. We're moving more patients through quickly but we've outstripped our housekeeping ability to keep up and we've outstripped our unit support workers ability to keep up……what the nurses are doing in PTA is non-nursing: it is washing stretchers; making stretchers and physicians too, I've got pictures of physicians washing stretchers somewhere; stocking equipment; moving patients around the department; porter entry; a lot of that stuff."*

Demand Outstrips Capacity – Demands for ED services keeps increasing in EDs across Canada. If capacity does not increase proportionately to the demand, it becomes challenging to provide the ideal service. That is what was pointed out by 3 participants. Regarding intake areas, they mentioned that such units do not function as expected if the population increases and outruns its capacity; and RAZ may be of little help if the number of patients assessed exceeds the number of patients already assessed and waiting for admission. They noted that if the capacity of these Intake areas is inadequate compared to their demand, they won't be an efficient intervention to continue with.

> *"Actually the metrics improved for a short while. We are at a point now where the metrics actually returned to where they were initially. Which is very discouraging but could be, without too much work, reflected on the fact that our numbers increased dramatically. Like, I think our patient numbers are about 10% higher than they were last year and last year they were 10% higher than the year before. So that's a lot of people when you see 100,000 people over the course of two emergency rooms in a year. So we're a little discouraged"*

"Well no, as a concept it worked great, but our volumes keep getting higher and our admit no bed capacity keeps going up. So you can only do what you can do and sometimes you just run out of space."

Inadequate demand for designated streams (carve-out effect)- Reserving provider time for a particular group of patients can turn inefficient if demand for these units is low or highly variable, resulting in wasted capacity. This would be most likely to occur in hospitals that serve a small overall population (a context factor). It could also be caused by a design flaw (e.g., overly strict admission protocol). If the demand placed on streaming units is less than the resources reserved for them, the purpose of streaming would fail.

"I think the last thing that we did was we tried to---the whole thing about assigning a physician to the back area was an epic fail, because sometimes it wasn't busy enough and sometimes the doctors didn't take it serious. So they'd be like oh, we're not that busy and I'm just going to step out and go get a haircut…."

Impact of Context factors on Mechanisms-

We have identified four (4) context factors that could possibly impact the mechanisms underlying streaming interventions.

- **Lack/shortage of resources.** The principle of streaming interventions is to stream appropriate patients to dedicated resources. Now if there is a shortage of resources (finance or staff) or if the streaming units are not provided with dedicated resources then the purpose of streaming is not served. Shortage of resources would obstruct the establishment of protocolized units. Without such units it would be difficult to provide standardized care. The mechanism "prevention of lag time" would also not be triggered because of shortage of resources. For

instance, if labs are unable to provide services when needed, lag time would remain between multiple assessment & treatment steps.

- **Lack of outflow sites.** Streaming interventions improve efficiency by facilitating quick turnover of patients. If there is a lack of places for persons to go, patients then are not discharged from streaming units. They block the rapid turnover of beds, leaving other patients waiting for those assessment/ treatment spots. Lack of outflow sites affects the mechanisms "provision of standardized care" and "efficient use of space." In both cases, the mechanisms are not triggered as there is an obstruction to turnover of patients. If patients in standardized units do not get discharged or if a higher number of patients are not served in streaming units then those relevant mechanisms never get triggered.

- **Demand outstrips capacity.** Demand placed on streaming units is not usually under the control of the intervention or the hospital. If the demand outstrips the capacity of the streaming units, patients cannot be served as expected. Patients might be waiting only for the services they need, but, if the demand for those services increases, this mechanism might be prevented from translating into greater efficiency. Excessive demand on services might impact reduction of variability among patients. Amidst high demand, streaming units might be forced to cater to cases that vary widely, hampering their efficiency.

- **Inadequate demand for designated streams (carve-out effect)-** It might also happen that resources are reserved for a designated stream, but the demand for those services is inadequate. Such a situation might prevent a few mechanisms from being triggered. For instance, standardized care for quicker recovery cannot be provided if insufficient patients are streamed to SSUs. There won't be any efficiency if dedicated spaces go underutilized.

4.6 Additional Outcomes (negative and positive)

Neglect of Acute Cases- When any unit starts focusing on a particular category of patients, chances are they might neglect other patients. This could be because they are strictly reserved for specific patients or their physicians might not feel responsible for other cases. Streaming interventions are likely to fall into this dilemma since they mostly function as a reserve unit. One participant warned that physicians in Rapid Assessment Units might overlook acute cases. There is also a possibility that if assessment beds are fully occupied, higher acuity patients might need to wait instead of low acuity ones who could still be treated. This might disappoint patients and families as well as service providers since less acute patients are being prioritized over more acute ones.

> *"…. So sometimes you can have like an eighty-year-old, weak and dizzy person that's more acute that's a CTAS 2 that will be bypassed because we've become so efficient with the CTAS 3 group. But NAME has done a really good job on articulating that to the physicians and saying no, your priority is still for the sickest patient."*

> *"… But there's bed block but I can see an ankle standing at the triage desk and I'll, suddenly that person is getting service because we, because the beds are blocked? You know, but you're just trying to move anyone at that point in time. So sometimes lower acuity people in the emergency department get faster care than the people that are sicker, and that troubles all of us."*

Breach of confidentiality. Streaming interventions in which multiple patients are being seen in a confined space may not be able to provide patients with the desired level of privacy and confidentiality. This could be uncomfortable for both physicians and patients. Patients might not give the complete history because they are not provided with any privacy, and without a complete history, physicians might mismanage cases. Moreover, to see a patient with a potentially traumatic, stigmatizing or embarrassing problem (e.g., bleeding in pregnancy, STD, assault) in a broom closet or the waiting room is arguably inhumane and disrespectful.

". And so, just the physical layout. It's pretty hard to be creative without stepping on top of one another and I mean the risk of some of this stuff is you lose the confidentiality piece of it in the Emerg Department and that is so critically important. But when I go back to the concept of the rapid assessment zones, you take them and then you move them to a situation and you have a conversation, but there's a patient beside you. Like there's no room, four walls with a door where you can have a confidential conversation"

Escaping Metrics – Participants pointed out that there were instances where patients were moved from Emergency Department to SSUs only to avoid their impact on overall ED LOS. Some even suggested that the whole motive for an SSU was to create the appearance of lower ED LOS, even though nothing changed from the patient's perspective. This sort of "gaming" is a potential negative outcome for the system.

"And what was happening that I remember was we compartmentalized the ED length of stay and all we did was shift these patients and say you're not in the measurement anymore. So that's not appropriate right, because all you do---from the patient's perspective they're still in there that period of time, but from our measurement perspective where you're kind of looking at just the ED segment and the length of stay and I think you need to look at the whole thing."

". The more you transition a patient the worse they do. The research is very, very clear on that. But we did that because that was what we had to look at and we were told Emergency was our focus and we had to improve processes in Emergency, full stop; do it. So that's where often times process improvement is driven by executives and largely public outcry and not thoughtful."

"I: And what's the advantage of having that as a separate unit versus just somewhere in the emergency? If the emergency were just expanded with an extra –
P: Do you want my honest –
I: Yes, yes.
P: CIHI is the answer.
I: Really? Okay.
P: Because otherwise if you – the patient is in the ER, he counts as an ER patient and then your ER stays are very long... it's the same, right. You could have him in the ER and have a red tape and say once they are over here they were no longer in the ER. It would be the same."

Getting seen by doctors sooner.– MTA and RAZ provide an opportunity for patients to be assessed sooner. They change the order of process steps, putting physician assessment earlier in the process instead of putting it immediately prior to treatment. Through dedicated resources available in these units, patients get assessed and discharged sooner which improves the overall efficiency of patient flow.

> *"And so we've created these areas sort of intake areas where the docs will sort of: we'll get the nurses there; we'll get the patients in the room and the doc goes in and sees the patients and the idea is you're getting more patients in front of the docs sooner and then you can improve your overall efficiency."*

Reduction of number of admissions. Moving patients from ED to SSUs prevents admissions to acute care. Patients are observed or treated in those units and often, though not always, discharged home. This reduces short-term admissions.

> *"....we've implemented a diagnostic and treatment unit, a four bed unit that the emergency doctors run, which has avoided admissions of patients. So someone who just needs a short stay for some either treatment or observation, that kind of thing for short period of time, it really reduces the volume of admissions, and so we've seen positive[s] from that. "*

> *"... So it saves an admit, treats the patient, does the appropriate work-up but it doesn't consume a hospital bed…It lowers the length of stay for people who do need short admissions and has fewer people being admitted to the hospital overall."*

Prevention of multiple handovers. Patients who have longer stays in the Emergency Department are prone to multiple handovers, gaps in information exchange, and poor outcomes. This could be due to the rotation of physicians or lack of case-specific expertise, or delayed response or need for prolonged care. Participants pointed out that having Short -Stay Units prevents such handovers. Patients are pulled from the ED to these specialized units where they are taken care

of by a consistent provider. This also ensures patients are supported in a less chaotic environment.

> *" And we were looking for that population to come to our clinical assessment unit recognizing that that would take a large burden off of emerg because those patients, not only do they have a longer stay but it generally means that there's multiple handovers from emergency physician to emergency physician. So from a safety perspective although every individual care provider was competent there was too many handovers; one would recognize for a population that requires that level of observation, follow-up and monitoring is not well served by a cascade of clinicians"*

> *"..Certainly the length of stay just in that unit is very good but it also takes away patients that would be handed over two, or three or four times from shift to shift in the emergency department. So it takes a segment of work off the plate of the emerg physician in terms of following-up and reassessing and handing over and moving them away. So I think that's been good for our flow but the emerg department's flow as well."*

4.7 Implementation Issues

In the course of our realist analysis of streaming interventions, some implementation issues were identified. Some of these factors are the reasons for their success, and some are relevant to their failure. Implementation issues were mainly relevant to staff engagement and need for up-front resources.

Staff engagement – A certain number of intervention and implementation drivers of staff engagement have been identified from the study. Most of them seem to lead to negative outcomes, i.e. staff might lose engagement; others might be the reason for their increased willingness to get involved with the intervention.

Negative outcomes-

Participants noted that physicians might lose engagement with an intervention if very few patients are being served, or if they are responsible for too many patients at the same time,

leading to a loss of efficiency. Physicians might also demand variations in the patients they visit. All these intervention design features should to be taken into considered to maintain physician engagement.

> *"But the docs did not want to have to stay assigned to one area or the other because they like variety in what they see. So I like seeing one or two of these life-threatened people in a day and then I like seeing some of the walking wounded and the people who are potentially very serious, they're an intellectual challenge, so I like to work with them, but I like to do it the way I am used to."*

A number of implementation features could also impact staff engagement with the intervention. Physicians might feel that it was unfair to see less acute patients earlier. Family physicians may be uncomfortable referring patients to SSUs or might refer inappropriate patients. One of the participants also pointed out that there might be less buy-in from physicians if there are unwanted changes to their practice pattern.

> *"In those cases I mean I think a lot of the barriers I think to Emergency Department flow are competing values. The clinicians, you know early on in that putting in those intake areas, a lot of the clinicians would kind of I don't know if resent, but they were a little reticent about putting that in because maybe it wasn't fair. You were maybe seeing some less sick patients faster, which in terms of flow is good because you move them out of your department and you don't have to manage them, but there was maybe a perception of unfairness. …… Early on there was a reluctance to send patients to those…... So there was to some extent reluctance to triage patients to that area"*

> *"P: From the physicians, first of all, so many physicians were not comfortable doing triaging. They were not comfortable seeing the patient and they want elaborate tests to be done on everybody. That was one of the problems."*

Every new intervention usually leads to a change in workflow or administration. This change might come as a threat to some service providers. One of the participants pointed out the fact that implementation of RAZ/Intake areas would be difficult if nurses find it a threat to their position.

"The nurses didn't buy it because they would see it – like, you don't need a triage nurse...you're going to eliminate that position and then what about us, right. So there's that protection of territory that was happening. So due to those reasons it never really got a chance to – we couldn't even pilot it. We couldn't even get a chance to try it out and see if it and this worked."

Positive outcomes

Physicians may be on-board if they are provided with favorable working conditions or if the interventions benefit them financially.

" And the Intake thing works well as well, because I mean it's financially beneficial to have well-organized set up that allows you to see six to eight patients rapidly in your first two hours."

A successful intervention could further motivate the people associated with it. One participant noted that resistance to new interventions starts decreasing once the positive effects begin to show up. Staff may also be willing to participate in an intervention, if they are led by dynamic leaders; Such increased motivation was noticed surrounding RAZ/Intake areas.

"When we started the I-team there was a lot of grumbling, a lot of the charge nurses, rah rah rah. Triage rah rah rah. Within two days they saw the impact it was having in the back and they totally changed their tune and then they went, 'Wow, we love this'".

"P: It was about a person. She was a very strong champion. She went into it with very strong, positive working relationships with the staff and with the docs. And they had physicians at that site that were willing to participate on the work or in the work and it was just a very strong team.
I: And by contrast the other Emergency Departments perhaps didn't have a dynamo like her.
P: No, they did not".

Need for up-front resources. Streaming interventions may have a cost associated with their implementation. Resources need to be allocated to them for their smooth functioning. In the absence of such up-front investment of resources or allocation of staff, streaming interventions can neither be implemented nor be made functional.

> *"The problem with introducing streaming is that streaming does take resources so although in the end streaming is actually resource neutral because you need less resources for some of the other areas, to initiate it you need to increase resources temporarily and that's until people pick up the pace.*

4.8 Perceived Effectiveness of Interventions

As described earlier, we were able to assess only participants' perceptions of intervention effectiveness, not actual effectiveness. It was important to find out whether these perceptions had any reliability; that is, did participants give similar assessments of the same intervention at the same site? From a realist perspective, we expected that participants would describe similar interventions as effective at some sites and ineffective at others, but it would be difficult to draw any inferences if participants frequently disagreed on whether the same intervention, at the same site, was effective or ineffective. It would also be problematic if what some participants called a design flaw was often mentioned as a useful feature by different participants. Thus, to identify possible discrepancies among participants regarding interventions at particular sites, a table was generated *(Appendix 5).* The table summarizes the data on which hospitals have implemented each type of intervention and whether the intervention was described as successful or unsuccessful, thus showing whether participants agreed on the outcomes of the same intervention implemented in the same hospital. It also gives us a glimpse of the total number of participants

that considered a streaming intervention effective or ineffective, and the most common reasons for such judgements.

Minor Treatment Area (MTA)/ Fast Track (FT). Only three participants provided details on the effectiveness of MTA. In two of the three mentioned sites, MTA was reported to be ineffective since it was being used as parking space for ‘to be ‘ admitted patients. At the other site, the verdict on MTA differed among participants. One said that MTA at *Hospital L* was working fine since it relieved the Emergency Department of some patients. The other said that not enough patients were reaching the unit, resulting in doctors sitting idle despite the ED being crowded (carve-out effect). It is to be noted that the latter one worked at *Hospital L*. Now, these comments might not necessarily be contradictory. MTA might be somewhat effective at the site, but it may not be performing to its fullest. However, it would be necessary to fully investigate the discrepancy before drawing conclusions.

Intake Area/ Rapid Assessment Zone (RAZ). RAZ was being considered as an effective intervention at 9 sites, across different cities, by 21 study participants. At only 2 sites RAZ was reported to be ineffective, and these sites either lacked a dedicated physician or had no outflow of patients from the units. Two different outlooks on RAZ were noted at one site, *Hospital Q*. Some participants were very positive and said the unit at the site was functioning well since patients were being screened earlier and less acute patients did not have to wait for care; others, however, reported issues with physician engagement. Doctors usually preferred seeing variety in patients they serve and RAZ lacked those variations. The different viewpoints not necessarily mean they were contradictory, rather they could both be true. The intervention might have all the necessary design feature for effectiveness, but it could still be difficult to implement. It was

reported that the issue at *Hospital Q* was later resolved by a dynamic leader who motivated the doctors to cooperate with the intervention.

Among the participants who considered RAZ as an effective intervention in general, 3 of them were not very confident about it at *Hospital R*. They were concerned about another implementation issue: nurses were uncomfortable sending patients to those units due to privacy concerns. They also warned that demand on that site might exceed the capacity of that ED, undermining the effectiveness of RAZ.

SSUs (SSUs) – As discussed earlier, there are different types of SSUs spread across Western Canada. Some sites may have different types of SSUs with distinct purposes, other might have only one SSU which may have either a specific purpose or a broad, vaguely defined purpose. From the transcripts we noticed that at some cities they are termed DTUs or MAUs and at other cities RAU, RADU or RTU. They not only differ in terms of their names, but also in the way they operate. Each unit's patient care, administration, physical space, operating hours including time of stay; differ from city to city and sometimes from unit to unit.

We found that Diagnostic & Treatment Unit (DTU), a type of SSU, was considered effective at most sites with exception of two. The sites where they were not effective, they were virtual in nature, i.e. those sites lacked designated physical space. Lack of such space was considered the cause for ineffectiveness of DTU at those sites.

Medical Admission Unit (MAU), an in-patient type of SSU, was considered ineffective at all 3 sites by 3 participants. Each of them raised separate issues related to its perceived ineffectiveness. One participant commented that sufficient patients were not reaching the unit thus the unit was getting expensive to maintain. Another participant said that when all other units

got full, it was difficult for the patient to be displaced elsewhere, thus they ended up staying in the SSU. A participant from a different site also considered MAU as failed intervention since too much transitioning of patients (from ED to MAU to other units) was having a detrimental effect on health.

Clinical Admission Unit (CAU), had mixed reviews from multiple sites in the same region. 4 participants considered it an effective intervention at 2 *Hospitals (W, V).* These sites identified the short stay patient appropriately and took in socially complex patients who would have otherwise burdened the ED. However, 6 participants considered the CAU program a failure overall since the units got stagnant due to lack of outflow of patients, which was related to the policy of admitting long-term patients (usually ALC patients, or patients that are frail, elderly with multiple co-morbidities, that need a wide range of services and/or are slow responders to treatment). The desirability of admitting long-term patients was a genuine source of disagreement among participants, though most considered the practice undesirable.

Other SSUs were not discussed by many participants. One participant contrasted a Rapid Assessment Unit (RAU) and Rapid Assessment & Diagnostic Unit (RADU), which s/he considered effective and ineffective respectively. The reason for RADU being ineffective was identified as to do with its administration. RAU patients were admitted under a hospitalist and tended to stay longer failing the purpose of the SSU; RADU patients (at *Hospital G*) were admitted under an ER physician and discharged efficiently. It is to be noted that these conclusions were drawn by a single participant.

As we notice from the table, there were seldom disagreements about the same intervention in the same place. Where discrepancies existed, usually participants were focusing on different outcomes; for example, one might have commented on the ease or difficulty of implementation,

while another commented on whether ED LOS had decreased. This finding lends credibility to the idea that the design features and context factors identified in this thesis reflect something more than individuals' idiosyncratic perceptions. However, we should be cautious of drawing inferences about actual intervention effectiveness since no more than 4 people (the majority of the time only 1 person) discussed the same intervention in the same place.

It would have been possible to investigate further by acquiring publicly available data on each hospital's statistics (e.g. hospital size, patient volume, admission rate, number of units, etc.) and using them in the analysis of context. However, this was beyond the scope of the thesis for three reasons. Firstly, it would not be consistent with a theory based approach (a realist approach), as typically we would be looking into data that is relevant to a theory that has already been proposed. Secondly, few participants discussed each intervention per site, so even if we identified a strong influence of a site features on the intervention, the evidence to support or refute that would be weak. Lastly, it would be a time-consuming task to compile all publicly available information about the characteristics of all 27 hospitals and would not be worthwhile if we were not able reach any conclusion.

CHAPTER 5: DISCUSSION

We analyzed a large number of open-ended interviews through a realist approach in order to identify the reasons behind the success or failure of streaming interventions. Perceived reasons included design elements and design flaws, as well as external conditions that affected the ability of streaming interventions to achieve their desired impact. Our work was grounded in the Population-Capacity-Process model, which helped us categorize factors in a meaningful way. As anticipated, streaming interventions had been implemented at multiple locations, but their features and the context differed in ways that helped to explain why interventions succeeded in some places and not in others.

When we started exploring why an intervention was perceived to work, there were certain design features that were common among interventions. In keeping with the Population-Capacity-Process model, the identification of a designated population by the interventions seemed to be a design feature found at all successful sites. It was reported that effective Fast track units identify 'less-acute' cases and RAZ/Intake areas cater to 'mid-acute' or 'unknown' cases. There was no single definition of the target population for SSUs, which was not unexpected. Different sites had implemented different types of SSUs, which had their own preferred population and defined their admission criteria differently. For instance, Diagnostic and treatment units (DTU) were the commonest form of SSU in the Vancouver area; in Manitoba, Clinical Assessment units (CAU) were popular; Medical Assessment Units (MAU) or Rapid Assessment Units (RAU) were mostly found in Alberta. It was not clear whether participants in different regions shared the same definition of each of these models; a few participants seemed to clearly differentiate between different types of SSUs, while others seemed to define them much more approximately. The administration, admission criteria and functionality of these SSUs differed from site to site,

which is congruent to what we found in literature (80,81). One thing that was common, however, was that the sites reporting positive outcomes were most likely to be those that clearly defined, and remained loyal to, their 'short-stay' population. When a site lacked, or did not enforce, strict admission criteria, poor outcomes were reported by most participants. These findings are consistent with previous studies on Observation Units. Protocol-driven dedicated observation units have been associated with the best outcomes (95,96) and if a unit is protocol-driven, it is implied that it defines the population that would receive the protocol.

The Population-Capacity-Process model identifies that for an intervention to work smoothly, a designated population should be directed to a dedicated capacity. While searching for capacity issues in the data, we found that at sites where dedicated space was allocated for streaming interventions, those sites reportedly succeeded; whereas in places where space was not available, the intervention was perceived to have failed. We also noticed at some places, the space reserved for streaming interventions were being used for other purposes, for example as an extension of Emergency Department's bed base or holding places for in-patients. At all such sites where space was not being reserved for streaming interventions, the interventions did not reach the expected outcome. Similar was the case with distribution of resources (i.e., finances, physicians and/or support staff). At sites where there was a shortage of resources or resources were being shared, streaming interventions at those sites seemed less efficient. Head to head comparison between SSUs having dedicated space (Type 1) and SSUs not having dedicated space (Type 3) were not found in the literature, but studies do suggest that possessing a dedicated unit ensures that clinicians and equipment are in close proximity which prevents disruption of processes and aids efficiency (97).

The Population-Capacity-Process model also states that the designated population needs to reach the designated capacity through an established and consistent process. We noticed that the RAZ/Intake areas that were perceived to be functional had such an established process. Providers in those units were aware of the need of rapidity as well as the need for high turnover, thus, they acted accordingly. Among the SSUs, we noticed that at sites where SSUs maintained their 'short' time-frame, they were reported to be functioning efficiently. Service providers associated with such units were consistent with serving the patient within the pre-defined time frame. Only the appropriate patient population was streamed to these units, and cases anticipated to have a longer stay were not admitted. This strict strategy might have helped maintain the turnover of patients through the units, increasing the overall efficiency. Previous studies had cautioned that poor management and inadequate operational policies might affect the functioning of SSUs. They warned that these units might turn into a 'dumping area' for patients and the overall workload might increase if these units did not maintain a strict time frame (90).

Realist analysis provides an opportunity to identify underlying mechanisms of complex interventions. Our study also identified several such mechanisms. Though most of these mechanisms were not stated explicitly, participants seemed to imply them. Most of them were in line with what was suggested in the literature, namely: streaming interventions help improve patient flow because they ensure that patients wait for only those services they need; help reduce variability among patients, which enables efficient use of resources; prevent lag time between patient care steps by having a dedicated care team in a defined geographical location; and facilitate provision of standardized care thus enabling quicker recovery.

Besides recognition of all the mechanisms that were to some extent touched on in the literature, we identified two more mechanisms from the interviews. Implementation of streaming

interventions tends to improve efficiency by promoting a change in attitude throughout the Emergency Department as well as the entire hospital. Service providers in direct or indirect contact with these units tend to develop the mindset to quicken the patient care process. At sites where the intervention was deemed to be successful, this mindset later seems to spread thought the hospital, improving overall efficiency of patient care. Streaming interventions, especially Rapid Assessment Zones/ Intake areas help improve efficiency because they utilize their allocated space to the maximum. An important activity linked to this mechanism is that patients are treated in an upright position, which increases the number of patients being served without compromising the quality of care. Because of the change in the way care is provided more patients can be served and discharged through the same confined space that previously served a lesser number of patients. Prior articles have mentioned the importance of 'vertical care'; we see this as one activity that would lead to the overall mechanism of efficient use of space.

Context factors and their impact

A number of contextual factors were identified through this study. These factors were external to the interventions and were out of scope for the Emergency Departments. They were the conditions that affected the ability of streaming interventions to reach their desired impact. Scarcity of outflow sites was one such contextual factor. Patients that were already managed got stuck within RAZ or SSUs since there were no available discharge locations. After assessment and initial treatment patients were supposed to proceed to their next place of care, which could include discharge home, an inpatient bed, nursing home or any other location external to the Emergency Department. This would help with the turnover of patients through the streaming units; however, the lack of outflow sites hinders the flow of those already-served patients.

Previous studies have also warned about such scarcity of outflow sites (98,99). This shortage of outflow sites might be due to a lack of inpatient beds or community beds, where patients need to be transferred after being stabilized in the ED; either way, unless stabilized patients are transferred to those beds from the streaming units, smooth patient flow will be obstructed.

Another important context factor is an increasing level of demand for Emergency Department services, which may reflect population increases, patient preferences, a lack of alternative care options, or a combination of these. Even the streaming interventions may be overwhelmed by this growing demand. Every unit or hospital has some limitation over its capacity, and if the demand outstrips the capacity the system is bound to fail. This situation was narrated by some participants regarding Rapid Assessment Zones in a few sites. When the demand increases drastically, the Rapid zones do not remain rapid anymore. Their efficiency decreases as eligible patients are kept waiting to get into these already filled units. An intervention might be designed and implemented appropriately; it might be efficient, serving a large number of patients in short period of time with minimum resources; but the intervention might still fail if the demand placed on it far exceeds its turnover capacity.

The principle of streaming interventions is to dedicate capacity to a defined population so that they do not have to wait for services they do not need. But such confinement of capacity might give rise to a phenomenon called the ‘carve-out’ effect (60). If the demand placed on the streaming units is less than the allocated capacity, services may be underutilized. Physicians or nurses might be restricted to a unit where they would be sitting idle, whereas other units are being flooded with patients. This contextual factor was also identified from one of the study sites, and how it might affect the efficiency of the unit has been discussed. Finding the right balance of patients and capacity is something the stakeholders need to consider while

implementing streaming interventions. If the streaming criteria into these units are too relaxed the units might be overburdened, and if the criteria are too strict, resources might get underutilized. In both the cases efficiency of these units might be hampered.

A graphical representation on how the above stated contextual factors might obstruct the triggering of mechanisms is provided in *Appendix 6.* Application of streaming interventions might cause patients to wait only for those services they need (mechanism 1), but if demand placed on the units exceeds the unit's capacity, it will become full; then, patients will still have to wait for services and patient flow may not improve. The streaming units might also remain full if there are is a lack of outflow sites. Patients would still be left waiting for the services they need, affecting patient flow.

Also, if demand outstrips capacity of streaming units, variability among patients would not be reduced *(Mechanism 2*), as service providers might accept inappropriate types of patients in order to cope with the demand. In some instances *Mechanism 2* might be triggered but it won't lead to improved patient flow because of the carve-out effect. Streaming units would be serving similar categories of patients but the number of patients being served might be too low to generate efficiency.

Factors such as lack of resources might impede the triggering of provision of standardized care *(Mechanism 3)* because delivery of such care would need dedicated physical space and appropriate staffing. Standardized care might be activated by implementing streaming interventions, but patient flow might still not improve if there is lack of outflow sites i.e. if the units remain filled and are not able to serve new patients.

If physicians and nurses are not available simultaneously (lack of resources), lag time between care steps cannot be prevented *(Mechanism 4)*. For the mechanism to be triggered all necessary resources required for patient care should be accessible and preferably within the same location. An important mechanism triggered through implementation of streaming intervention is the efficient use of allocated space *(Mechanism 6)*. Now, if sufficient patients do not reach the unit (carve-out effect) or if patients are stuck in the unit due to lack of outflow sites then the units are not being efficiently used. Without efficient use of space, overall efficiency won't improve. Participants did not discuss any context factors that threatened the promotion of change in attitude (*Mechanism 5*). There might be factors that could have influenced the spreading of positive attitude across the site, for instance, relationship between ED and other units, relationship between healthcare staffs, etc.; however, since these concerns were not raised in relevance to streaming interventions, they are not addressed here. The true contextual factors that this study identified are mostly capacity related, thus if demand outstrips the capacity and/or if there is lack of resources or outflow sites, most of the mechanisms might not be triggered, or may fail to translate into flow outcomes. No matter how well the streaming intervention has been designed or executed, if those context factors are not addressed the underlying mechanism that would lead to the outcome will not be activated.

Our qualitative exploration revealed the causes and conditions that lead to success or failure of streaming interventions, which was our primary intention. But, we were also able to identify certain other outcomes of the interventions, most of which were not previously highlighted in related literature. These outcomes, though not unanimously stated by participants, seemed like situations that stakeholders need to watch for. Ensuring dedicated services to less acute patients through streaming might be viewed as an unfair step if acute cases are waiting in queues for their

services. Increasing efficiency by serving multiple patients in the same spot might raise patient confidentiality concerns among service providers. This confidentiality issue has also been repeatedly identified in the literature (100). Stakeholders should also be careful of the motive behind the use of streaming units. It may happen that patients are being transferred to those units solely for the purpose of keeping the Length of Stay (LOS) of ED down to avoid repercussions.

Cross-tabulation of streaming interventions

In order to understand to what extent participants agreed or disagreed on where a particular intervention was effective or ineffective; the cross-tab *(Appendix 5)* was compiled. It was necessary to cross compare among sites since the same site might have been perceived effective by one participant and not by others. It functioned as a reliability check of the features and flaws identified in our results section. Also, the cross-tab gave us an opportunity to detect whether some interventions were discussed more positively or negatively by the participants. Though the number of participants that discussed the effectiveness of particular intervention *per site* was low, the complete table gives us a sense of the overall scenario. There were very few discrepancies in terms of perception of effectiveness, and at sites where there were discrepancies, the opinions were not contradictory. Discussion mostly surrounded Rapid Assessment Zones and various types of SSUs.

Rapid Assessment Zones (RAZ)/Intake areas seemed to be the intervention most participants were satisfied with. The only factors that were impeding its effectiveness was availability of a dedicated physician or lack of outflow sites both of which were site issue.

Minor Treatment Areas or Fast Track units were scantily discussed in the interviews, thus conclusions could not be reached, but it was clear that at some sites the MTAs were not being used as they were intended. Instead, they were being used as parking space for probable inpatients. At another site, the MTA was serving fewer number of patient and doctors allocated to the units were sitting idle. Ironically at the same site the Emergency Department was crowded and patients were being kept waiting for services. It is important to note that MTAs were a longstanding intervention at many sites; participants who thought they were working well might not have thought to mention such an old initiative, or might have taken them for granted.

Our findings suggest that a wide range of short-stay units operate in Western Canada. Each of them has their own way of functioning and similar types of units might be implemented differently at different sites. For example, of the 6 sites where DTU was said to be operating, two sites had a virtual type of unit which a participant perceived as the reason for its ineffectiveness. MAUs were considered unsuccessful at all the operating sites and the reasons for the ineffectiveness differed from site to site. According to (most) participants, the success and failure of CAUs were related to the type of patients they admit. If long term patients are admitted and there is no outflow of the patients the units might be of less benefit. As noted earlier, some sites seemed to clearly differentiate among different types of SSUs, but most reported only one type, whose name did not necessarily indicate a specific model.

Apparent reasons for failure

The most common explanation for the failure of streaming-type interventions is that the interventions were not designed the way they were supposed to be used. They lacked the

essential design features necessary for their posited mechanisms to operate. To use evaluation language, these initiatives displayed "low fidelity" to the intended intervention. The commonest flaw, in all the three types of streaming interventions, was lack of dedicated capacity. At sites where interventions shared their physicians or had no physical space earmarked for its patients, interventions were reported to have failed. Designating a particular population was another important design element that was overlooked at some sites, specifically in regard to SSUs; at sites where the units poorly defined their patient population, those sites reported failure with the intervention. Also, since the patient population was not clearly defined at certain SSUs they lacked consistency and rapidity in their process of care. They were not able to maintain the allotted time-frame as patients were stuck in the unit for an indefinite period, obstructing the flow of patients through those units.

A notable insight from this thesis was that most of the reasons reported for intervention failure had to do with intervention fidelity. In many of the cases where participants reported that streaming-type intervention did not work, they described a low-fidelity form of the intervention. It is not surprising that low-fidelity interventions were reported to fail, but it seems surprising that sites are implementing low-fidelity interventions and are expecting them to work. (A few participants might claim that such low-fidelity interventions work anyway, but such claims would need to be tested, since the interventions are not of the same kind reported in the literature.)

When an intervention works in one site but not in another, one might assume that the difference in context is the cause of failure, and that the solution might be to alter the context, if possible. However, if the interventions are not identical, the cause might lie with the interventions itself. There could be lack of intervention fidelity at failed sites which needs to be considered before

blaming the contextual factors. Once these design flaws are resolved chances are the intervention might start functioning; there might have been no hard-to-resolve contextual issues in the first place. This thesis was able to identify important breaches of intervention fidelity with the help of population-capacity-process model, which guided this analysis.

The above discussion is not meant to downplay the importance of context. We know that context can prevent a mechanism from operating or achieving its intended outcome despite the presence of all the ideal design features. In *Appendix 5*, we notice that at *Hospital B*, none of the participants mentioned any design flaw in its Rapid Assessment Zone; but it still was termed ineffective since there was no outflow of patients. Similar was the case with *Hospital P;* the SSU there was deemed ineffective only because patients were not being discharged elsewhere (all other places were already occupied). In both these cases, the issue might not have been low-fidelity of an intervention instead it would have be the contextual factor (lack of outflow sites), that could have resulted in failure of the interventions. Context factors are external to the intervention, thus resolving them would need collaborative commitment and/or environmental modification.

Context factors vs. design flaws

If we compare between SSUs (CAUs) at *Hospital V & Z,* we notice that *Hospital V* seemingly had outflow issue. The unit there either got swamped with sheer volume of patients or the site lacked sufficient space to discharge the patients - both of which are contextual factors that are not within the control of its ED. On the other hand, *Hospital Z* admits long term patients which is a major design flaw. SSUs are intended for short term patients; their patients need to be

discharged within the set time frame to ensure proper turnover. In both the cases it was the same intervention, one was designed appropriately but had contextual issues and the other lacked intervention fidelity, apparently both failed. But, the intervention at the site with design flaw might have been saved through local measures. In this particular scenario, it is worth mentioning that the design flaw (admission of long term patients) might have to do with an actual or perceived inability to access outflow sites for long-term type patients. There might have been limited options for such patients to be discharged, forcing the unit to admit the patients. The issue of admission of persons with long-term needs was also identified in a previous study (94). SSUs were being used as a 'parking lot' for long-term patients whose destination was not finalized. Such use of streaming unit did not resolve the problem, instead the blockage to patient flow merely relocated from ED to SSUs.

Context factors do sometimes influence the design features of interventions. They make it difficult to maintain intervention fidelity. For instance, if adequate resources, such as finance, are not allocated to a streaming-type intervention it would be difficult to ensure a dedicated space for it. Building or earmarking a physical space for any intervention is an expensive procedure which requires financial commitment. Similar is the case with sharing of physicians between units. Dedicating physicians, nurses or staff is a resource intensive process. In the absence of adequate resources, interventions cannot be designed the way they should be. When units are flooded with patients and/or if there are no outflow sites, inappropriate patients might have to be admitted to the units to cope with the pressure. An important design feature of streaming type-interventions is ensuring admission of patients they are intended for, but contextual factors such as the ones mentioned above might force them into accepting other types of patients. To prevent variation among patients, streaming type interventions could establish strict admission criteria- an

important design feature of such interventions. But, such strict admission procedure could influence development of a 'carve-out' effect.

Similarities & Dissimilarities between Streaming-type interventions:

All the streaming-type interventions have similar principles, be it MTA, RAZ or SSU. Their motive is to stream out patients to relieve the ED from some burden. They are intended to prevent unnecessary waits for cases that could be resolved in a setup other than main ED, thus improving the overall efficiency of the ED. Though the motives of such interventions are similar, they vary to some extent in terms of design features and the resources they utilize. Identification of appropriate populations, allocation of distinct physical space and availability of dedicated physicians were design features that were found common across all three types of streaming interventions. Absence of dedicated space was the only design flaw that might have affected all the three streaming interventions. Design features like targeted discharge and maintenance of strict time frames were discussed only for SSUs; rapidity in assessment of patients was identified as an important feature of Rapid Assessment Zones. Sharing of physicians might be a concern only among Rapid Assessment Zones and Minor Treatment Areas, whereas admission of long term patients, misuse of allocated space and failure to maintain strict criteria were flaws of SSUs as highlighted by the participants.

Context factors surrounding the interventions might also differ from intervention to intervention or from site to site. For instance, lack of outflow sites and inadequacy of resources were the context factors identified as affecting Rapid Assessment Zones and Short-Stay Units. Excessive demand on interventions and carve-out effects were only discussed for Intake areas and Minor

Treatment Areas respectively. It is worth stating that other than the ones discussed above, there might be overlap of certain design flaws or context factors among the interventions which the participants might have missed . For instance, carve-out effects might also be noticed among SSUs, but such situations were not considered here since they were not explicitly stated.

Implications and future research potential

The various design elements and design flaws identified in this thesis might help potential stakeholders who plan to implement streaming-type interventions at their sites. The mechanisms identified might provide informative insights to those who plan on studying these interventions. Decision-makers can benefit from the context factors recognized in this thesis and take necessary steps to resolve them collaboratively. Stakeholders from individual sites, dealing with unsuccessful streaming-type interventions, could check for potential design flaws in their interventions as recommended in this thesis. A list of suggestions derived from participants' reported experiences *(Appendix 7)* has been presented for guidance of decision-makers who are planning on implementing a streaming intervention in near future. By following the items in the list, one might be able to prevent probable issues from emerging.

This thesis merely provides possible explanations underlying the success or failure of streaming-type interventions. Participants' theories are not concrete evidence, thus they must be tested through further research. I would speculate that participants might be able to identify internal design flaws more accurately than external concrete factors. They have experienced the issues; thus, they might have been able to pinpoint the underlying cause of intervention failure at their site (or elsewhere). However, the participants may or may not be accurate in terms of applying

the correct intervention description and identifying the context factors. It is particularly difficult to get to the bottom of such factors since they are mostly external to the ED. The participant might have thought that there is lack of resource or there is lack of outflow sites, but they may be wrong. There could have been sufficient resources which were not used efficiently; maybe there were sufficient outflow sites but were not accessible due to process issues; or the outflow sites might have gotten filled by inappropriate patients.

Streaming-type interventions such as MTA, RAZ and SSU have been studied previously, but their evidence base was still not strong enough. Most of the studies were single-site and focused on assessing quantitative effectiveness. None of the studies qualitatively explored the underlying reasons for success or failure of the interventions. Multi-site studies were also limited and cross-comparison across similar interventions at different sites were also not found. This study tries to fill this gap in literature. Streaming interventions have the potential to improve patient flow. This study thus tried to establish the programme theory and identify the underlying factors that could have led to success or failure of such interventions. It should provide guidance to stakeholders who are interested in implementing such interventions. It also paves the way for future research as the theories provided here needed to be tested. Similar research could also be carried out on other families of patient flow interventions.

CHAPTER 6: LIMITATIONS AND CONCLUSION

Limitations

Interviews analyzed in this study were not solely intended for streaming interventions. They were part of a broad study that covered a variety of patient flow related issues. Thus, comprehensive information on streaming interventions was not available. Some participants did not mention streaming interventions; others mentioned them only in passing or discussed them broadly, skipping finer details. Still, the large dataset comprising information from multiple sites strengthened the ability to draw reasonable inferences about the interventions. Evidence on outcomes of the interventions was unavailable, thus we had to limit ourselves to realist analysis, based on participant perceptions, instead of a realist evaluation. However, the realist approach did help us unwind the mechanisms and identify key contextual factors for the execution of these complex interventions. To ensure maximum yield from the data available, the whole dataset was read multiple times for relevant information. Also, at one point the information started to seem repetitive with no new themes emerging. Collection of extra interviews were thus not needed since data seemed to reach saturation. Gaps might still be present and future research could be directed specifically to collect details on streaming interventions.

The interview sample included multiple managerial roles and levels as appropriate to the overall research questions of the broader study; however, it did not include frontline providers, who might have offered important perspectives on specific interventions. Since the participants had to describe events or experiences from their current as well as their former workplaces, recall bias was a possibility, but it was to some extent controlled as participants typically focused on events

they could clearly remember. Also, there was a chance for social desirability bias as the participants were asked to provide information on interventions they were associated with, including failed interventions; participants might have answered in a way they thought was more socially acceptable rather than the way they really felt. However, the broad and somewhat informal nature of the interview questions, which covered overall flow experiences not confined to any particular intervention or site, should have helped to minimize any perceived pressure to respond in a certain way. The reliance on a single coder during the main analysis might have carried a risk of researcher bias, but it is worth mentioning that my supervisor was constantly monitoring the coding process and provided extensive feedback at several junctures; interpretations were established by consensus.

Participants discussed multiple flow related interventions in the interviews. The names and features of interventions differed from site to site, thus mislabeling of intervention by the participants was a possibility. However, during the primary analysis, coders including myself and others ensured that interventions were correctly identified in the transcripts, and data that could not be linked to appropriate interventions were excluded from the analysis.

Conclusion

Our results suggest that streaming interventions operate somewhat differently at different sites. Each Emergency Department has its own unique 'signature' and varies in executing the same intervention. This could be the major reason why intervention outcomes differed from site to site. Previous research only focused on whether streaming interventions was effective or not; they prioritized gathering evidence in favor of or against the intervention. There were no granular

reviews of flow interventions, nor any realist evaluation that tried to explore the causes underlying the success or failure of interventions. This study tried to minimize this particular gap in literature. It tried to explore 'why an intervention works' rather than focusing on 'does this intervention work?'.

As highlighted in the literature review section of this thesis, the evidence base for streaming intervention is not strong enough. Most of the studies did reveal positive results, but the results varied so much that concrete conclusions could not be reached. Additionally, the possibility of publication bias cannot be ignored. Absence of qualitative exploration on streaming interventions also established the need for this thesis. It was important for a realist analysis to be carried out for guidance of stakeholders who plan to implement streaming interventions at their respective jurisdictions.

All the above findings help us understand how streaming interventions work, what are their common grounds for success across sites and what associated factors need to be taken care of to achieve the desired results. The theories or the CMO configurations generated through this study might help stakeholders in taking informed decisions on streaming interventions. They could also provide a foundation for future research in which the theories could be tested and concrete conclusions could be reached.

Streaming-type interventions have the potential to improve patient flow. They can relieve the ED from patient burden and help improve overall efficiency. Thus, when these interventions fail at any site, instead of moving on to the next intervention stakeholders might focus on identifying any possible design or contextual issues and work to resolve them. Taking such steps might revive the intervention and prevent incurring a waste of effort and financial resources.

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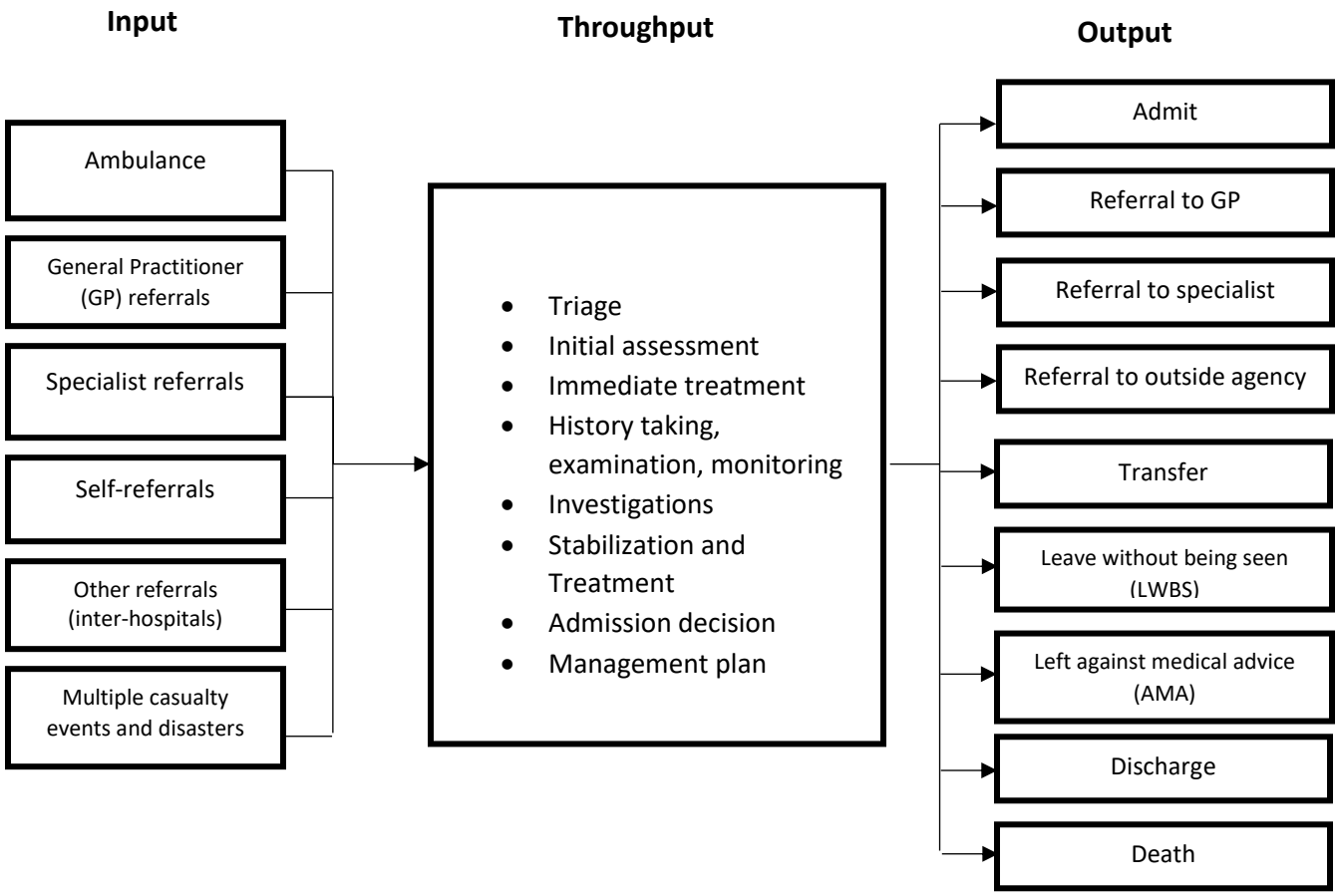
APPENDICES

Appendix 1: Input-Throughput-output conceptual model of ED overcrowding

(*Source: Review of the Quality of Care and Safety of Patients Requiring Access to Emergency Department Care and Cancer Surgery and the Role and Process of Physician Advocacy. Health Quality Council of Alberta. 2011, based on Asplin et al., 2003).*



Appendix 2: Brief list of Interventions

(*Source: Review of the Quality of Care and Safety of Patients Requiring Access to Emergency Department Care and Cancer Surgery and the Role and Process of Physician Advocacy. Health Quality Council of Alberta. 2011).*

Input	Throughput	Output
Media campaigns/diversions	ED Navigators	Bed co-ordination
Ambulance Diversions	Triage Activities	**Clinical Decision Units (CDUs)**
Walk-In- clinics	Care Maps	**Observation units**
Influenza Pandemics (SARs, H1N1)	Triage liaison physicians (TLP)	Over-capacity protocols
Telephone Health Line	**Fast-track areas**	**Medical Admission Units (MAUs)**
	Rapid Assessment Zone (RAZ)	Discharge Lounges
	Computerized physician order entry (CPOE)	Increased LTC beds
	Improving laboratory testing	
	Bedside ultrasound in the ED	
	Nurse Practitioners in the ED	
System Wide Interventions		
Multifaceted interventions (eg. UK 4 hour rule)		
Pay for performance (P4P) incentive models		
Accountability frame-works		
Bench-marking/reporting		

Appendix 3: Interview guides

INTERVIEW GUIDES – "Patient Flow and the Health System" – Version 1, May 22, 2015
FOR GENERAL INTERVIEWS (most participants)
[Begin by introducing self and the study – interested in issues, strategies and challenges related to patient flow across the continuum of care.]

1. How long have you worked at [region name]? How long in [name of site or program]?

2. What has been your involvement in efforts to improve flow?
- What would you say has worked well? What hasn't?
- How about flow efforts at the regional level – how effective would you say these have been? What has been effective/not effective?

3. Within the structure of the region, who has responsibility for improving flow? (If clarification requested: Is it [sites/programs/geographic hubs/corporate office/etc.]?) Who should? How clear is it who's accountable for what? Any other comments about how the region's structure affects flow?
- [If there has been a restructuring within that person's memory]: I am aware that…(describe). How has this affected / will this affect patient flow?

4. Sometimes, an effort to improve flow for one group of patients makes things worse for another. Have you seen this happening? (Could you give me an example? Any more examples?) What has been done to address this? What do you think should be done? How common is this scenario?
- How about the reverse scenario – can you think of an effort to improve flow for one group of patients that also helped another? (If participant reports an expectation of benefit, ask about evidence that these benefits were realized.) How common is this?

5. When your (program/site/etc.) has undertaken efforts to improve flow, how is the decision made? (Probes: by whom, on what basis, using what information, through any specific process?)
- How about when the region chooses flow initiatives or strategies? (Probes: How transparent is the process? How systematic? To what extent are individual decisions linked to an overall strategy?)
- Some flow strategies focus on a defined population, others not. To what extent is defining a population part of the decision-making process? (Probes: How is that done? and/or How important do you think that is?)

6. How much consistency is there in the flow efforts undertaken by different sites or communities? How much should there be? (What is being done about this? What should be done?)

7. Sometimes, difficult working relationships between groups in the system can pose challenges for improving flow. To what extent is that an issue in this region? (Which groups? To what extent have relationships improved or worsened, and why? Which relationships are positive?)

8. Is there anything else we should know in order to understand patient flow in this region?
- [Probe: Important flow issues/challenges we haven't covered? Issues unique to this region?]
- Are there any internal reports or documents we should read to get a better understanding?
- May we follow up with you if we have questions about [your work/Project X]?
- (If needed, ask if they could pass along an invitation e-mail to colleagues)

FOR INTERVIEWS THAT FOCUS ON A SPECIFIC PROJECT/INITIATIVE

[Note: During the process of qualitative data collection, we may find that certain initiative(s) seem particularly important to understanding performance at the regional and/or site level. In this event, we will use the questions below for initial interviews with new participants who were involved in that particular initiative. We may also use one or more of these questions in a brief follow-up phone interviews with participants who have already completed a more general interview.]

1. How long have you worked at [region name]? How long in [name of site or program]?

2. Please describe the [name of project] and your role in it.
   - Probe: May ask questions to verify or clarify information in documents collected.

3. How did you choose this particular initiative [OR this package of initiatives]?
   - Probes: What problem were you trying to solve?
   - Where did you get the idea? (What other ideas did you consider?)
   - To what extent was defining a population part of the decision-making process?
   - Who was involved in the decision to choose this idea?
   - How is/was the initiative supposed to work – what are the active ingredients?

4. Can you walk me through the process of implementing the initiative?
   - Probe: What strategies did you use? Can you give me more details?
   - What worked well? What didn't work well?
   - What barriers did you encounter to implementing the initiative? How did you address them?
   - How did the initiative change from what was initially planned? Why?
   - (for successful projects if applicable) Have you also been trying to spread the initiative to other [units/departments]? How have you tried to do this? (Repeat probes above if there has been a separate implementation process focused on spread.)

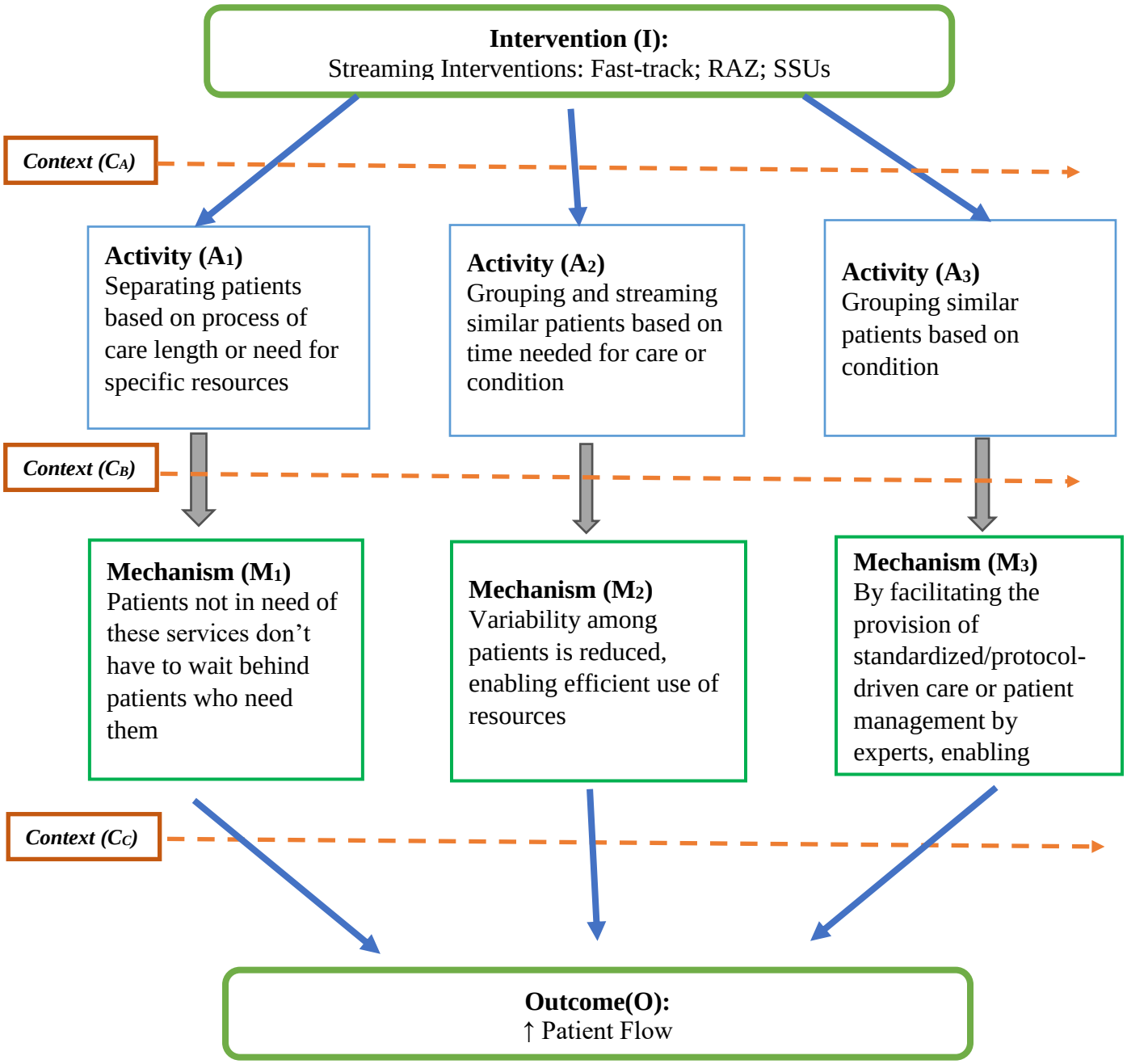
5. It seems that this initiative/strategy/project[describe outcome, based on documents of which participant is already aware].
[OR if documents were not provided]: What was this initiative/strategy/project's impact on flow? (What did you measure? When? Is there any documentation I could look at?)
   - Probe for clarification if the response is vague.
   - What do you think were the main reasons why this occurred?

6. What have you learned from this initiative?
   - Probe: What would you do differently in future?
   - Probe: What advice would you give other [programs/sites/organizations] who are trying to improve patient flow?

[If an initial interview, proceed to questions 3, 4 and 7 of general interview guide as time permits]

7. Is there anything else we should know?
   - (If needed, ask if they could pass along an invitation e-mail to colleagues)

Appendix 4: Sample AMO configuration



Appendix 5: Cross-tabulation among interventions and sites

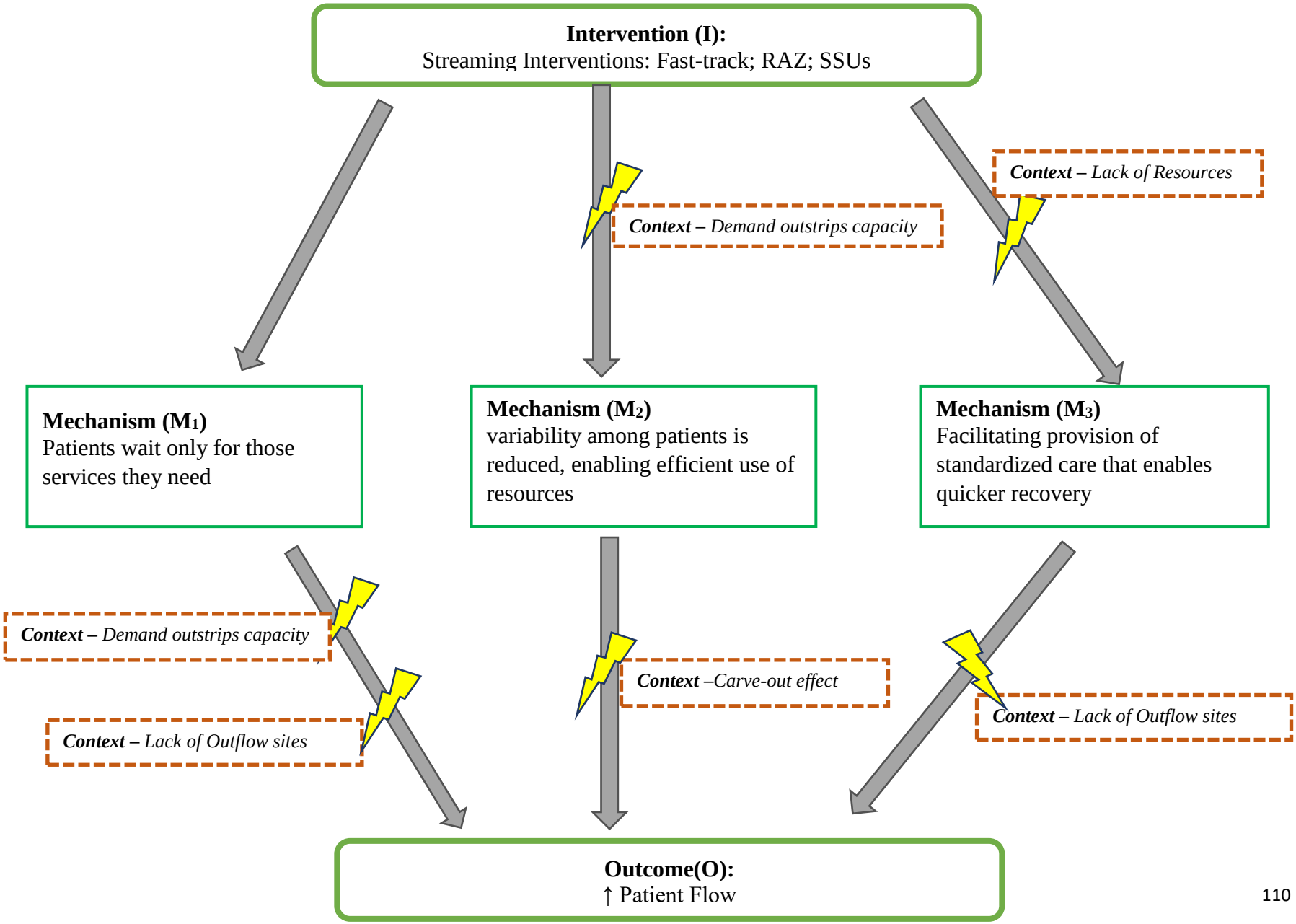
Intervention	Organization	City	Effective/ Ineffective	Reason for effectiveness	Reason for Ineffectiveness	# Effective	# Ineffective
RAZ	A	01	Effective	• Availability of physical space • Rapid cycle time	• (growing demand for the service might be an issue)	3	0
RAZ	B	01	Ineffective		• no outflow of patients	0	1
RAZ	P	09	Effective	• Addresses the unknown population • Appropriate physician and nurse buy-in • Do not change patients to gown		4	0
RAZ	Q	09	Both	• Patients keep rotating • Less acute patients do not wait for care • Patients reach physician early	• doctors less willing since there is no variety in the patients	2	1
RAZ	R	09	Effective (not too confident)	• Availability of physical space • Takes pressure off ED	• Huge population growth , • ED size is insufficient; • nurses are uncomfortable sending patients due to privacy concerns.	3	0
RAZ	M	08	Effective	• patients keep rotating		1	0
RAZ	N	08	Effective	• Less acute patients do not wait for care		1	0
RAZ (PTA)	U	10	Ineffective		• No dedicated physician- they run back and forth between departments	0	1
RAZ	V	11	Effective	• Less utilization of beds • Simultaneous care by nurse and physician		4	0
RAZ	W	11	Effective	• doesn't take up stretcher space		2	0
RAZ	X	11	Effective			1	0
RAZ	AA	11	Effective	• Keeping patients in chairs frees horizontal space		1	0

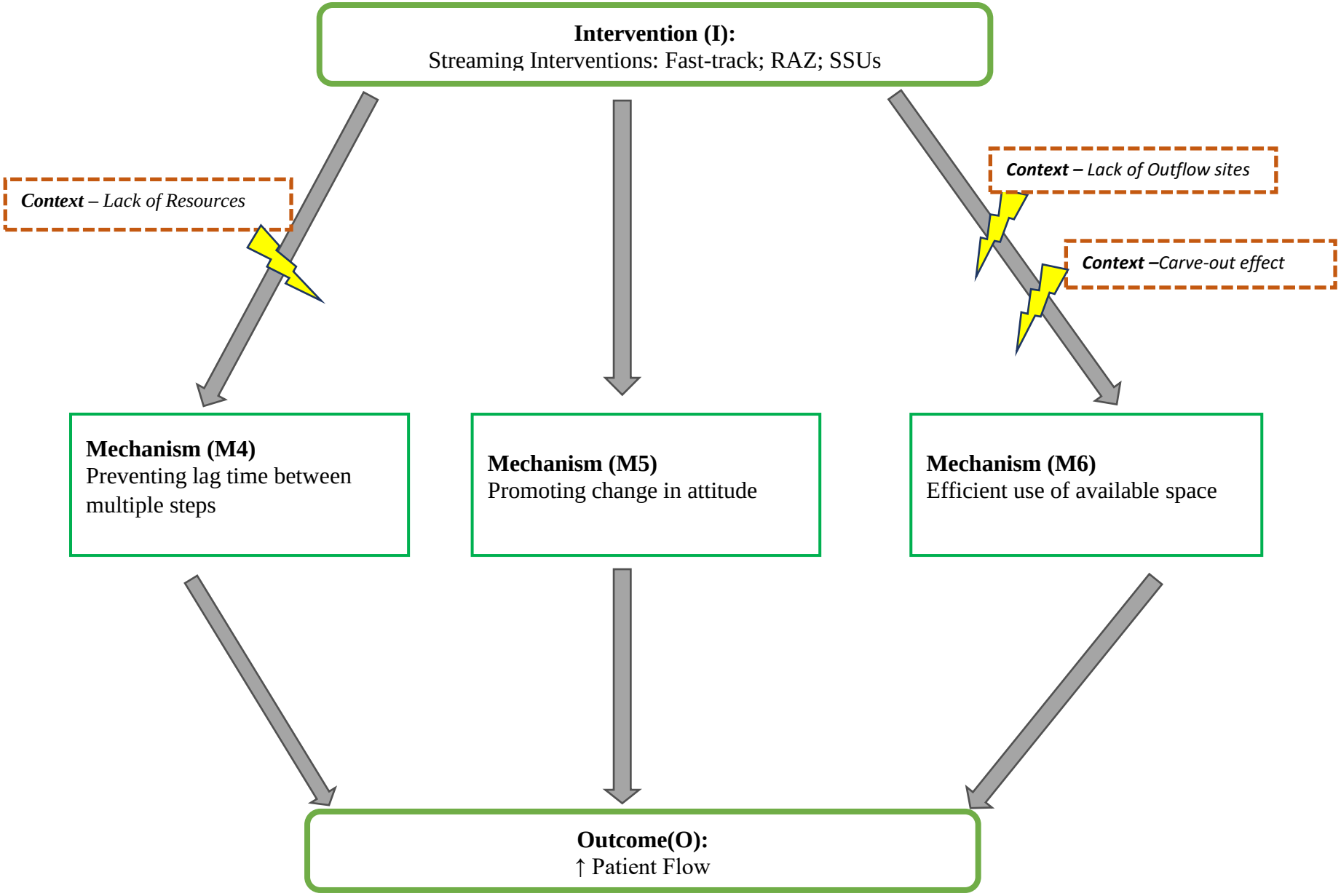
Intervention	Organization	City	Effective/ Ineffective	Reason for effectiveness	Reason for Ineffectiveness	# Effective	# Ineffective
MTA	L	07	Both	• relieves the ED from some patients	• less patients reach the unit- physicians sit idle- *(carve out effect)*	1	1
MTA	X	11	Ineffective		• being used as parking space for 'to-be' admitted patients	0	1
MTA	Y	11	Ineffective		• being used as parking space for 'to-be' admitted patients	0	1
DTU	A	01	Effective	• Has physical space to maintain a unit		1	0
DTU	C	01	Effective	• Has physical space to maintain a unit		1	0
DTU	B	01	Ineffective		• No Physical Space	0	1
DTU	E	01	Ineffective		• Virtual- no physical space	0	1
DTU	F	01	Effective	• Ingrained nature of service provider, they know they should either admit or discharge patient, can't keep them in the unit for long.		1	0
DTU	D	01	Effective			1	0
DTU	I	04	Effective			1	0
72 hr	K	06	Effective	• relieves the ED from some patients		1	0
MAU	C	01	Ineffective		• was getting expensive, not enough patients	0	1
MAU	P	09	Ineffective		• everything got full and patients ended up staying there	0	1
MAU	S	09	Ineffective		• too much transitioning has detrimental effect on patients	0	1

Intervention	Organization	City	Effective/ Ineffective	Reason for effectiveness	Reason for Ineffectiveness	# Effective	# Ineffective
CAU	W	11	Effective	• clear buy-in from ED, • identifies people that are truly short stay, refer patients to family medicine dept. when needed		2	0
CAU	V	11	Both	• takes in socially complex patients,	• some outflow issues; • admission of long term patients	2	2
CAU	AA	11	Ineffective		• they are full, no outflow of patients	0	3
CAU	Z	11	Ineffective		• admission of long term patients	0	1
RADU	G	02	Effective	• admitted under ER physician		1	0
RADU	H (?)	03	Ineffective		• if admitted under hospitalists, they are in-patient, thus tend to stay longer	0	1
RADU	C (?)	01	Ineffective		• if admitted under hospitalists, they are in-patient, thus tend to stay longer	0	1
RAU	P	09	Effective	• physicians were on board, patients were being referred to the unit		1	0
RAU	T	09	Effective			1	0
MDU	O	08	Ineffective		• beds have become extension beds	0	1
RTU	M	08	Effective	• prevents fill-up, • open till 11 pm only		1	0

*Streaming interventions were mentioned as being present in other hospitals too, but there weren't enough details to include them in the table. There were instances where the site of intervention was unclear from the conversation, those sites were marked by (?)- query sign and the most probable location was considered.

Appendix 6: CMO configurations




Intervention (I):
Streaming Interventions: Fast-track; RAZ; SSUs
Context *– Lack of Resources*
Context *– Lack of Outflow sites*
Context *–Carve-out effect*
Mechanism (M4)
Preventing lag time between multiple steps
Mechanism (M5)
Promoting change in attitude
Mechanism (M6)
Efficient use of available space
Outcome(O):
↑ Patient Flow

Appendix 7: List of suggestions derived from participant's reported experiences

For Fast Track Units/ Minor Treatment Areas (MTA):

- **Availability of dedicated physical space-** The space should not be used as 'parking lot', even during crisis.
- **Availability of dedicated physicians** – Physicians should not be moving back & forth between multiple departments.
- Ensure that ONLY 'low-acuity' cases are served.
- Ensure that enough patients reach the unit – if needed the patient acceptance criteria should be optimized.

For Intake Area/ Rapid Assessment Zone (RAZ):

- **Availability of dedicated physical space-** The space should not be used as 'parking lot', even during crisis.
- **Availability of dedicated physicians –** Physicians should not be moving back & forth between multiple departments.
- Addresses the mid-acute cases- the ones that can be served in upright position.
- Addresses the unknown population- the ones that would need some work to be done before reaching conclusion.
- Ensure simultaneous care by nurses & physicians – there should be no lag time between service providers.
- Ensure rapidity of the process – patients need to be assessed, treated and discharged to the earliest.
- Appropriate buy-in from nurses & physicians – they need to be comfortable serving patients in such units.

For Short Stay Units (SSUs, any type):

- **Availability of dedicated physical space-** The space should not be used as 'parking lot', even during crisis
    - preferably not a 'virtual' unit
    - The space should not be used as generic overcapacity space
    - Beds do not become extension beds
- Addresses patients that could ONLY be served within a defined time frame
    - Does not admit long term patients or patients that would block the beds
    - Does not admit ALC cases, since they are unpredictable
    - Defined Patient Population- can't just admit patients to relieve pressure of ED
- Provide more critical thinking and staff support for targeted discharge
- Maintain strict time frame
    - Ensure patients next destination within the time frame
    - Staff are aware to either admit or discharge, no hanging patients
- Ensure that enough patients reach the unit – if needed the patient acceptance criteria should be optimized.
- All stakeholders are on board, they are sending in the patients
- Preferably admitted under ER physician

Overall- These are contextual issues and might need time and extensive collaboration to resolve but are necessary factors to be considered.

- Ensure sufficient outflow sites – discharge location should be ensured, could be inpatient beds, could be community, or any other facility.
- Ensure adequate resources – financial allocation, equipment, staff, etc.
- Prevent Carve-out effect -
- Ensure demand does not outstrip the capacity

} Units should be designed based on demand & admission criteria should be optimized accordingly

Appendix 8: University of Manitoba HREB Ethics Approval Forms

P126-770 Bannatyne Avenue
Winnipeg, Manitoba
Canada, R3E 0W3
Telephone : 204-789-3255
Fax: 204-789-3414

UNIVERSITY OF MANITOBA | Bannatyne Campus
Research Ethics Board

HEALTH RESEARCH ETHICS BOARD (HREB)
CERTIFICATE OF FINAL APPROVAL FOR NEW STUDIES
Full Board Review

PRINCIPAL INVESTIGATOR:	INSTITUTION/DEPARTMENT:	ETHICS #:
Dr. S. Kreindler	U of M/Community Health Sciences	HS18666 (H2015:232)
HREB MEETING DATE:	**APPROVAL DATE:**	**EXPIRY DATE:**
June 22, 2015	July 9, 2015	**June 22, 2016**
STUDENT PRINCIPAL INVESTIGATOR SUPERVISOR (If applicable):		

PROTOCOL NUMBER:	PROJECT OR PROTOCOL TITLE:
NA	Patient Flow and Health Systems
SPONSORING AGENCIES AND/OR COORDINATING GROUPS:	
Research Manitoba	

Submission Date(s) of Investigator Documents:	REB Receipt Date(s) of Documents:
May 22 and July 7, 2015	May 25 and July 8, 2015

THE FOLLOWING ARE APPROVED FOR USE:

Document Name	Version(if applicable)	Date
Protocol:		
Protocol Revised REB Submission Form		May 22, 2015 submitted July 7, 2015
Consent and Assent Form(s):		
Research Participant Information and Consent Form (Manitoba Participants) Participant Consent Form (Alberta Participants) Consent Form – B.C. Participants Participant Consent Form (Saskatchewan Participants)	V. 1	May 21, 2015 May 21, 2015 22 May 2015 Submitted May 22, 2015
Other:		
Invitation to Participate Interview Guides		May 22, 2015 May 22, 2015

CERTIFICATION
The University of Manitoba (UM) Health Research Board (HREB) has reviewed the research study/project named on this ***Certificate of Final Approval*** at the ***full board meeting*** date noted above and was found to be acceptable on ethical grounds for research involving human participants. The study/project and documents listed above was granted final approval by the Chair or Acting Chair, UM HREB.

HREB ATTESTATION
The University of Manitoba (UM) Health Research Board (HREB) is organized and operates according to Health Canada/ICH Good Clinical Practices, Tri-Council Policy Statement 2, and the applicable laws and regulations of Manitoba.

In respect to clinical trials, the HREB complies with the membership requirements for Research Ethics Boards defined in Division 5 of the Food and Drug Regulations of Canada and carries out its functions in a manner consistent with Good Clinical Practices.

QUALITY ASSURANCE

The University of Manitoba Research Quality Management Office may request to review research documentation from this research study/project to demonstrate compliance with this approved protocol and the University of Manitoba Policy on the Ethics of Research Involving Humans.

CONDITIONS OF APPROVAL:

1. The study is acceptable on scientific and ethical grounds for the ethics of human use only. ***For logistics of performing the study, approval must be sought from the relevant institution(s).***
2. This research study/project is to be conducted by the local principal investigator listed on this certificate of approval.
3. The principal investigator has the responsibility for any other administrative or regulatory approvals that may pertain to the research study/project, and for ensuring that the authorized research is carried out according to governing law.
4. **This approval is valid until the expiry date noted on this certificate of approval. A Bannatyne Campus Annual Study Status Report** must be submitted to the REB within 15-30 days of this expiry date.
5. Any changes of the protocol (including recruitment procedures, etc.), informed consent form(s) or documents must be reported to the HREB for consideration in advance of implementation of such changes on the **Bannatyne Campus Research Amendment Form.**
6. Adverse events and unanticipated problems must be reported to the REB as per Bannatyne Campus Research Boards Standard Operating procedures.
7. The UM HREB must be notified regarding discontinuation or study/project closure on the **Bannatyne Campus Final Study Status Report**.

Sincerely,

[redacted]

John, Arnett, PhD, C. Psych.
Chair, Health Research Ethics Board
Bannatyne Campus

Please quote the above Human Ethics Number on all correspondence.
Inquiries should be directed to the REB Secretary **Telephone**: (204) 789-3255/ **Fax**: (204) 789-3414