Achieving wait time reduction in the emergency department

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Abstract

Purpose – The purpose of this paper is to provide details on a study to determine the wait time and service time for various emergency department (ED) patient care processes and to apply the science of plan-do-study-act (PDSA) cycles to improve patient flow.

Design/methodology/approach – The paper used direct observation to collect patient flow data on 1,728 patients at multiple ED sites in Saskatchewan, Canada. It calculated wait times and services associated with important care processes and then tested, measured and implemented ideas to reduce wait time.

Findings – On an average, patients spend nearly five hours in the ED with about one-half of the visit devoted to waiting for the next required service to take place. Waiting for an inpatient bed, specialist consultation or physician reassessment comprised relatively long wait times. Through the use of visual reminders and standard process worksheets, quality improvement teams were able to achieve large reductions in physician reassessment waiting time. These improvements required minimal materials cost and no additional staff.

Research limitations/implications – The case study featured EDs within a particular Canadian province, so may not be generalizeable to other settings. We only sampled a fraction of ED patients at each facility.

Practical implications – Admitted patients waiting for a hospital bed represent a key contributor to ED congestion. PDSA cycles are a valuable approach to achieving quality improvement in health care.

Originality/value – The paper fulfils an identified need by breaking down an ED patient's waiting time into several high-level processes. It also applies improvement science to ED patient flow.

Keywords Emergency services, Waiting lists, Patient care, Canada

Paper type Case study

1. Introduction

Emergency departments (EDs) are an important hub in our health care system. They handle acute illnesses and injuries, are an important gateway to admission to hospitals and also provide medical care when a patient's regular physician is unavailable. Because of its central place in the health care system, problems in other parts of the system may be felt within the ED. These facilities are well known to the public, as Canadians make 14 million visits to ED annually (Canadian Institute for Health Information, 2005). Hence, problems in the ED may strongly influence public opinion about the whole health care system.

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Concerns about long waits in EDs exist throughout Canada (Canadian Institute for Health Information, 2005) and the situation in Saskatchewan is no exception. Media stories within this province have reported that overcrowding causes delays (McNairn, 2002; Klein and Haight, 2003) and that these delays create patient safety concerns (Cook, 2004). Moreover, these issues have been raised within debates among elected officials (Wood, 2004).

This case study describes work undertaken by the Health Quality Council in conjunction with the Saskatchewan Ministry of Health – the provincial government health care agency – and the Regina Qu'Appelle and Saskatoon health regions to measure and improve ED patient flow. We wanted to determine how long patients typically spend in the ED, how much of this time was devoted to waiting for medical attention (as opposed to receiving "hands-on" care), and the particular high-level activities that were key contributors to patient flow bottlenecks. We conducted the project in two phases. In Phase 1, data collectors obtained waiting time and processing time for key high-level activities within the five EDs in Saskatoon and Regina. The central tendencies and variability observed in these times were used to identify process improvement priority areas within the EDs. During Phase 2, quality improvement teams conducted various plan-do-study-act (PDSA) exercises (Langley *et al.*, 1996) to improve patient flow, streamline processes and reduce waiting time in the identified priority areas. Team members documented their work and used run charts to highlight changes in waiting times.

This paper proceeds as follows. We next provide a review of pertinent literature, followed by a description of our ED data collection activities for the various high-level processes. We then outline the main results of our data analysis (including the baseline waiting and service times), after which we present a thorough description of our quality improvement initiatives. Concluding remarks are offered in Section 6.

2. Literature review

The analysis of ED throughput and performance comprises a rich history. In a thorough attempt to review and categorize the literature, Zun (2009) reported on an extensive MEDLINE search using such terms as "turnaround", "efficiency" and "overcrowding". In fact, the author discovered 129 articles describing "ED efficiency". An important component of improving efficiency involves the reduction of patient throughput time. To this end, several previous studies have determined time intervals for important ED patient activities. Using data primarily from Ontario, researchers calculated a median length of stay of 128 minutes, although the longest 10 per cent of patients spent at least six hours in the ED (Canadian Institute for Health Information, 2005). Kyriacou *et al.* (1999) conducted a total of seven one-week time flow studies over a five-year period at a Los Angeles County ED. They calculated intervals for triage, registration, placement in an ED bed, initial medical assessment, disposition order and patient discharge (which could be transfer to an inpatient bed for an admitted patient). The authors found that the unavailability of inpatient beds contributed to significant delays. Over a three-month period, Arkun *et al.* (2010) utilized an observational study of adult patients waiting in an ED at a specific time each day. They determined that two of the factors that constricted flow involved day of the week and ED occupancy. A team of researchers at the Arizona Emergency Medicine Research Center (Spaite *et al.*, 2002) carried out a systematic process investigation of both ED waiting time and patient satisfaction. Specifically, they measured the time interval from triage to placement in bed, as well as the entire ED length of stay.

Perhaps, spurred by the public concern with ED overcrowding, researchers have continued to explore the contributing factors to this problem. This area is not without its controversy, as some authors suggest that the unavailability of inpatient unit beds contributes to upstream ED congestion and bottlenecks. In fact, a substantial number (85 per cent) of respondents to a survey of Canadian ED directors indicated inpatient bed unavailability was the principal cause to ED overcrowding (Canadian Agency for Drugs and Technologies in Health, 2006). Additional studies have reiterated the assertion that flow problems associated with admitted patients from the ED to the hospital leads to substantial congestion difficulties (Asplin *et al.*, 2003; Espinosa *et al.*, 2002; Kellermann, 2000; Schull *et al.*, 2003; Schull, 2005).

However, other studies claim that the impact of considerable numbers of low-acuity patients drives ED congestion. Siddharthan (1996) suggests that EDs enforce a "toll" on non-emergency users of the facility, so as to deter their usage. Such a toll could be created by widening the clinical definition of emergency patients – this would force non-emergency patients to linger longer before being seen, thus making them potentially less likely to visit an ED. Others have suggested that a fast-track facility could be used to efficiently cope with an onslaught of low-acuity patients, hence reducing their impact on overall congestion (Cooke *et al.*, 2002; Fernandes and Christenson, 1995; Rodi, 2006). Attempting to quell this debate, Schull *et al.* (2007) showed that greater numbers of low-acuity patients do not affect length of stay and "door to doctor" times for medium or high acuity patients.

A number of viable interventions designed to improve ED patient flow have appeared in the literature. These represent potential improvement initiatives that could be used by any ED facility desiring to reduce wait times. Ng (2006) adopted certain process adjustments such as locating clearly marked supplies and equipment in the right places, standardizing the organization of charts, and using treat and release area nurses to "pull" the patients as soon as an inpatient bed was available. Jacobsen and Resar (2006) suggest that hospitals orchestrate an inpatient's discharge earlier in the overall process. This would help to reduce the time interval associated with admitting an ED patient to a hospital bed. Haraden and Resar (2006) advocate the use of inpatient bed discharge slots, so patients would spend less time waiting in the ED for a hospital bed. Blake *et al.* (1996) developed a computer simulation model to show that increasing physician coverage hours at certain times in the ED would lead to reduced wait times. In a similar vein, Duguay and Chetouane (2007) used discrete event simulation analysis to demonstrate the extent of patient wait time reduction by adding one physician and one nurse.

The case study described in this paper fits broadly within the scope of quality improvement work. Other authors have depicted the application of these approaches in health care. In a successful effort to shorten patient length-of-stay, Dickson *et al.* (2009) portrayed how a hospital began ordering laboratory tests and X-rays earlier in a patient's ED journey and adopting a team approach to patient care. The latter idea was especially beneficial in helping to save staff time by reducing the duplication associated with taking patient histories. Macias and Patel (2009) applied a series of quality improvement cycles (also known as PDSA cycles) to improve the quality of care received by asthma patients. Reporting on over 200 quality improvement events conducted at a Seattle hospital, Stapleton *et al.* (2009) describe how continuous efforts to ameliorate processes has thrived in such applications as surgical site infections and ED throughput.

It may be tempting to suggest that adding capacity – through more ED or hospital beds – would fix flow problems. However, Haraden and Resar (2004) articulate that this is not the case. Simply adding more beds does not alleviate congestion difficulties; in fact, adding more ED beds – without exploring underlying flow issues – is akin to making the big end of a funnel even bigger (Institute for Healthcare Improvement, 2003). Indeed, until we tackle the variation in capacity levels (Silvester *et al.*, 2004) or length of stay (Gallivan *et al.*, 2002), patient flow problems will remain unresolved. The importance of fully addressing flow issues is further demonstrated by Eitel *et al.* (2010). They offer a thorough overview of several methods such as demand management, process mapping, lean methods and discrete event simulation modelling that can be used to analyze and improve ED patient flow.

3. Data collection

Quality in this study was defined in terms of timeliness of service. The global measure of quality is the total transit time, from the moment the patient enters the ED to be registered to when he or she leaves the ED. In order to gain further insight into where delays are occurring, we identified several high-level activities or "black boxes" that occur within the ED, and designed time-based measures for each of these activities. Rather than following the approach of other studies and restricting our attention to a few ED activities, we wanted to obtain important details on a number of care processes. These high-level activities include:

- triage;
- RN assessment;
- MD assessment (we kept track of which specialty performed this assessment, such as ER attending, ER resident, consultant service, family physician or "other");
- MD reassessment;
- procedure (we recorded the particular procedure performed, such as suturing, casting, applying a dressing, inserting an IV, etc. as well as the specific specialty involved in the procedure: RN, MD, consultant or "other");
- required observation (the time during which a patient occupied an ED bed while being "monitored" by a provider. For example, this could involve the time taken to observe the effects of medical drug administrations);
- blood work;
- urine tests;
- diagnostic testing (e.g. X-rays, CT scans, ultrasounds, ECGs);
- consultation (e.g. plastics, psychiatrics, cardiology, orthopedic surgery, etc.); and
- patient disposition (this involved activities related to discharging a patient home, or admitting them to an inpatient bed).

For each of the above activities (except triage), we distinguished between service times and wait times. Wait times represent the idle time experienced while waiting for the next service to be delivered, and add no value to the patient. A long wait associated with a particular process signals a bottleneck at that process. Service times represent the "hands-on" time that providers spent with patients. We did not aim to reduce service times for any individual service – nor did we challenge the clinical content of particular services – as we believed that the opportunity for health care providers to work significantly faster in any particular stage was limited. Our efforts to shrink wait times as opposed to service times are entirely consistent with the notion of lean process improvement (Womack and Jones, 2003; Womack *et al.*, 2005), in which waiting is viewed as a non-value-added activity. Service times, on the other hand, represent a value-added activity for the patient, since they are receiving direct care from a health care provider. A typical patient's journey in the ED begins with triage/registration, followed by an initial waiting time (the time interval between triage/registration and being placed in an ED bed). The time patients spend in an ED bed until discharge home or admission to the hospital is called "ED occupancy time". Table I lists definitions for each service and wait times.

We hired and trained nursing students in Saskatoon and Regina to conduct direct observation of patients moving through the ED. These students received a one-day orientation into the purpose and nature of the project, as well as an overview of our proposed data collection approach. Indeed, data collectors recorded details for a number of ED patients in adjacent beds simultaneously from the time the patients entered the care-giving area until leaving the ED. The students documented start and stop times of different processes using a clipboard and watch. We organized 12-hour collection shifts (800-2,000 daily), with two data collectors working simultaneously throughout the 12-hour stretch (each data collector independently followed a particular number of patients). In this way, we could follow patients whose journey in the ED overlapped data collection shifts.

Recognizing the infeasibility of capturing information on all ED arrivals, we encouraged our data collectors to follow those patients with higher acuity (i.e. those patients that presented with more severe conditions). This strategy was appealing since we felt that more acute patients would consume a relatively larger share of ED resources, and we wanted to capture situations in which a wide variety of resources were utilized.

We collected patient flow data on 1,728 patients during a nearly six-week period in July-August, 2005. Table II summarizes our data collection efforts. We selected these particular EDs owing to their location in Saskatchewan's two largest cities (the first three hospitals are situated in Saskatoon, while the latter two are Regina facilities). Further, provincial and health region officials felt that these five settings represented the province's major ED sites. We observed each ED over seven days (ten days for Royal University Hospital (RUH)). The Saskatoon's City (SCH) facility had lower patient volumes as its ED operates only 12 hours per day. In order to provide some measure of patient complexity at each facility, we tabulated the number of high-level activities per patient and noted the minimum (two activities in all hospitals) and maximum for each ED. Patients with only two activities had a relatively straightforward ED path (e.g. triage followed by discharge). Those patients with more activities would have iterated or cycled through particular black boxes (e.g. receiving multiple procedures or blood tests). Collected data were managed by Health Quality Council analysts and researchers who entered data into an electronic spreadsheet. This facilitated the calculation of wait and service times for each high-level activity.

Our data collection activities are not without their limitations. First, we were only able to sample a fraction of ED patients at each facility and therefore do not have

Table I. Terms defined

	Start time	Finish time
Service time in ED		
Triage	Start time of first visit with triage nurse	End time of last visit with triage nurse
RN assessment	Time that RN begins assessment	Time that RN finishes assessment
MD assessment	Time that MD begins assessment	Time that MD finishes assessment
MD reassessment	Time that MD begins reassessment	Time that MD finishes reassessment
Procedure	Time that procedure (suture, IV, dressing, etc.) begins	Time that procedure (suture, IV, dressing, etc.) finishes
Move patient to inpatient bed	Time that bed is ready	Time that patient is out of ED
Discharge activities	Time that discharge decision is made	Time that patient is out of ED
Required observation	Time that a request of patient staying in ED is given	Time that a repeated test or medication or MD reassessment is taken
Service time out-of-ED		
Draw blood	Time that phlebotomist enters patient's room	Time that phlebotomist comes out of patient's room
Urine Lab No. 1	Time when urine sample is received in lab	Time printed on first urine lab result
Urine Lab No. 2	Time when urine sample is received in lab	Time printed on last urine lab result
Blood Lab No. 1	Time when blood sample is received in lab	Time printed on first blood lab result
Blood Lab No. 2	Time when blood sample is received in lab	Time printed on last blood lab result
Consultation	Time that consultant enters patient's room	Time that consultant comes out of patient's room
Diagnostic testing[a]	Time that patient leaves to receive diagnostic testing	Time that patient comes back from testing
Wait time in-ED		
RN assessment	End time of the previous activity	Time that RN starts assessment
RN other	End time of the previous activity	Time that RN starts activity with patient (excluding assessment)
MD assessment	End time of the previous activity	Time that MD starts assessment
MD other	End time of the previous activity	Time that MD starts activities other than assessment
Urine transfer to lab	Time that urine sample is received	Time that lab receives the sample
Wait for discharge decision	End time of the previous activity	Time that a discharge decision is made
Wait time out-of-ED		
Draw blood	Time that the blood is ordered	Time that phlebotomist arrives
Blood transfer to lab	Time the phlebotomist leaves the room	Time the sample is received in lab
Diagnostic testing – wait for test	Time that diagnostic testing is ordered	Time that patient leaves ED to have testing done
Diagnostic testing – wait for report	Time that patient comes back from testing	Time that the diagnostic tests are received in the ED
Consultation	Time that consultation is ordered	Time that consultant comes to see the patient
Bed ready	Time that bed is ordered	Time that bed ready message is received
Summary		
Initial wait time	Time the patient is registered	Time the patient is put in a bed
ED occupancy time	Time the patient is put in a bed	Time the patient leaves the ED (admitted/discharged home/transferred)

Note: [a]If diagnostic testing is done in ED, e.g. ECG or portable X-ray, then the service time is from time that nurse enters the room until comes out for testing a complete view of the patient population. However, we feel that we gathered sufficient data to accurately determine baseline measures that could be used to guide quality improvement initiatives. Second, data collectors may have missed certain start or end times, due to food or washroom breaks. Moreover, in Regina General (RGH) we noted that some patient information appeared to have been lost for those patients who were moved to an observation unit located some distance away from the main ED area. This led to errors in the "bed ready" time at this hospital. Consequently, we adjusted for this discrepancy by examining RGH historical data for this particular process. Finally, we did not assess health outcomes or patient satisfaction. This project assumes that shorter waits correlate with greater satisfaction.

4. Results

Table III lists total transit time and total wait time for all five institutions combined and by Canadian Triage and Acuity Scale (CTAS) level. The CTAS is a five-level acuity guideline as to the maximum length of time patients ought to wait before their first assessment by an ED doctor. Patients with lower CTAS numbers represent more critically acute cases.

The total ED transit time ranged from two hours for the lowest acuity patients to six-and-a-half hours for those with highest acuity. The average transit time was nearly five hours. Overall, approximately one-half of total ED transit time is spent waiting. Higher acuity patients had longer transit times but wait far less. As we would expect, CTAS 1 patients requiring immediate resuscitation spent almost none of their transit time waiting.

Figure 1 shows the average initial wait time (from the completion of triage until the patient is placed in an ED bed). The most acute patients spend very little, if any, time waiting to be placed into a bed. CTAS 4 and 5 patients, on the other hand, have considerably longer waits during this part of their ED visit. We purposely under-sampled CTAS 5 patients (about 5 per cent of our sample had this acuity level). This may help to explain why

Table II.
Data collection summary

	Saskatoon City (SCH)	Royal University (RUH)	St Paul's (SPH)	Pasqua (PH)	Regina General (RGH)
Total patients observed	217	536	324	324	327
Maximum activities involved	19	24	21	26	27

Table III.
Wait times in ED by CTAS acuity level

Triage acuity level	Total transit time (minutes)	Total waiting time (minutes)	Percentage of total transit time spent waiting
All triage levels	285	142	50
CTAS 1	394	13	3
CTAS 2	391	163	42
CTAS 3	301	150	50
CTAS 4	224	129	58
CTAS 5	117	53	45

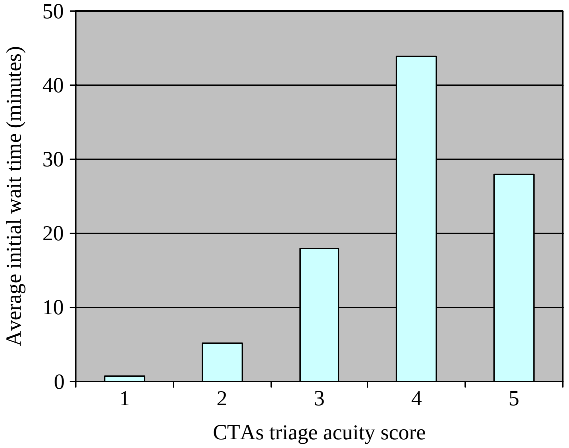


Figure 1. Average initial wait time

our small sample showed shorter initial wait times for this group of patients than for their CTAS 4 counterparts.

Recall that a major purpose of our case study was to document the times associated with important ED high-level activities. Table IV reports on the mean wait times for each process. In particular, patients admitted to an inpatient bed or who require a specialist consultation experience relatively long waits for these services. We now have additional evidence to bolster the claim that admitted patients waiting for a hospital bed represent a key contributor to ED congestion. Therefore, our work supports the literature suggesting that inpatients admitted directly through the ED – rather than a plethora of low-acuity patients – drives ED gridlock.

Waiting for a physician reassessment is another activity that consumes lengthy wait times. Some of these wait times were subject to considerable variability. For example, the top 10 per cent of waits for an inpatient bed were over eight hours long.

In Table V, we show average service times for each high-level process. Blood lab (for the last lab result) and required observation represent the longest activities. We note that wait times for specific activities (e.g. consultation, MD other/reassessment) are considerably longer than their corresponding service times.

Wait time	Mean (minutes)
Bed ready	211
Consultation	112
MD other (reassessment)	38
RN other	25
MD assessment	22
Urine transfer to lab	21
Wait for discharge decision	18
Diagnostic testing – wait for test	17
Draw blood	10
Blood transfer to lab	10
Diagnostic testing – wait for report	6
RN assessment	5

Table IV. Wait times for high-level ED activities

Table V.
Service times for high-level ED activities

Service time	Mean (minutes)
Blood Lab No. 2	26
Required observation	23
Diagnostic testing	15
MD assessment	14
RN assessment	11
Discharge activities	10
Urine Lab No. 2	9
Draw blood	7
MD reassessment	7
Triage	7
Procedure	6
Consultation	5
Move patient to inpatient bed	4

Figure 2 describes variation in wait times across the five Regina & Saskatoon EDs. Patients at Saskatoon's City and St Paul's Hospitals (SPH) experience the shortest average transit times, while Pasqua Hospital (PH) patients incur the longest times. From this, one can conclude that patient acuity and discharge rates affect transit time. For example, both SCH and SPH had relatively larger percentages of CTAS 5 patients (12 and 6 per cent, respectively) compared to the other hospitals (between 2 and 5 per cent). Patients presenting at the ED with non-urgent conditions generally have shorter transit times. In addition, both SCH and SPH had larger percentages of discharged patients (83 and 84 per cent, respectively) compared to the other facilities (between 71 and 78 per cent). Discharged patients do not incur long times in the ED waiting for an inpatient bed to become available. Thus, their transit times are shorter than those for admitted patients.

Figure 2 also shows that triage times are generally a minuscule part of a patient's entire length of stay, although SPH and RUH have relatively longer triage times than

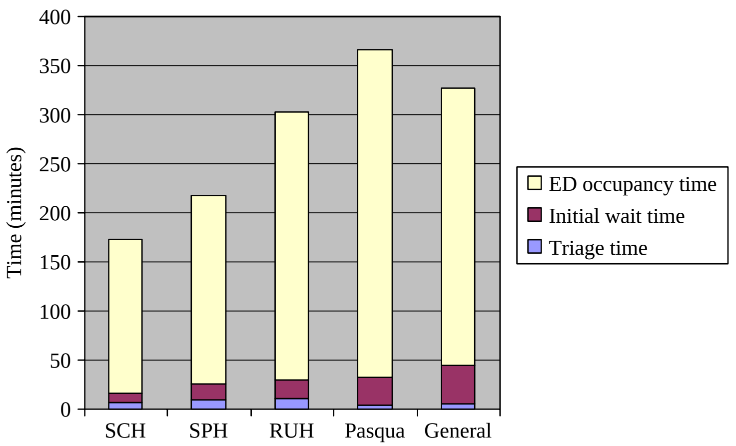


Figure 2.
ED transit time components

the other sites. Initial waiting times, another comparatively short part of a patient's ED visit, are longest at the Pasqua and RGH EDs and shortest at SCH. ED occupancy times dwarf the other components of transit time. Pasqua, General and RUH patients experienced relatively longer ED occupancy times.

5. Quality improvement initiatives

After completing Phase 1 data-gathering and analysis, our attention turned to testing, measuring and implementing improvement ideas in Phase 2. Given budget and project scope constraints, we decided to focus on reducing waits for physician reassessments (the so-called "MD other" wait time) at Saskatoon's RUH. It was for this reason that we did not specifically address improvement efforts surrounding the flow of admitted patients to a hospital bed.

The quality improvement team at this site targeted a 50 per cent reduction in wait time. Although teams tested ideas consistent with general change concepts for improving patient flow (Nolan *et al.*, 1996) and lean methodologies for eliminating waste, we note that the specific ideas for reducing physician reassessment wait time came directly from the quality improvement team members themselves. They recognized that Phase 1 data collection efforts revealed long waits for particular processes. Under the leadership of a skilled quality improvement facilitator, team members discussed possible root causes for the physician reassessment inefficiencies and proposed ideas that could tackle those causes, thereby shortening wait times. For example, more clearly marking the physician in charge for each patient could eliminate non-value-added steps and wastes of motion and time related to staff trying to identify the right physician. A standardized form to identify appropriateness of reassessment is consistent with the concept of process standardization.

The RUH team conducted a series of three PDSA cycles. Within these PDSA cycles, the team conducted small tests of various change ideas, often with multiple attempts for each idea with subtle variations of the change idea on each attempt. The learnings from these PDSA cycles guided the improvement team in designing a system which was acceptable to front-line staff and which produced tangible results. The deliberations within these PDSA cycles are documented in Table VI, while Table VII provides a "Physician Reassessment Worksheet" designed to improve process standardization. One of the challenges that the team faced was to remain focused on quality improvement activities. Team members were provided paid time to participate in their activities, but were at several key moments in time called in by their peers to do clinical duties due to crisis situations in the ED. To avoid this problem, the team eventually started meeting away from the ED (they met on the hospital's sixth floor) and did the improvement work in the ED in civilian clothing.

Figure 3 shows improvements resulting from these activities. Data were collected during our three improvement cycles and compared to the RUH baseline wait time of 43 minutes as obtained in our original data collection. The initial 12 points in the run chart correspond to typical wait times experienced prior to our improvement efforts. As demonstrated by our three improvement cycles, we observed a reduction in the average physician reassessment time to about 12 minutes.

Table VI.
PDSA cycles at RUH ED

Cycle number	Plan	Do	Study	Act
Idea 1, Cycle 1	Create colour code for responsible ED physician for each patient Use markers to colour code Train clerk with system	Carried out as planned	Clerk too busy	Try different colour coding system
Idea 1, Cycle 2	Use markers and dots Train 2nd clerk	Carried out as planned	One clerk adapts well; second stops process	Retrain 2nd clerk
Idea 1, Cycle 3	Retrain clerks ED physician trained to identify own patients with coloured dots	Carried out as planned	Process well accepted by MDs and clerks	Try next change idea
Idea 2, Cycle 1	Create visual reminder on whiteboard of ready for assessment Use magnetic reminder	Magnets do not stick well (plexiglass covers metal whiteboard)	Not able to carry out plan	Put sticky magnet strip on plexiglass; Stick magnets on strip
Idea 2, Cycle 2	Initiate visual reminder with self sticking colored paper strip on whiteboard	Carried out as planned	RNs not remembering to put visual reminder on whiteboard	Incorporate reminder into a worksheet for RNs
Idea 3, Cycle 1	Trial of "Think Reassessment" worksheet (Table VII) to help ED RNs know the appropriate time to ask MD to reassess	Tested on four patients	The new RNs like new form; physicians want form to note when a resident sees patient first and needs to reassess. Improved reassessment time (Figure 3 run chart)	Redesign form to incorporate resident information
Idea 3, Cycle 2	Trial of re-designed "Think Reassessment" form incorporating resident info	Tested on eight patients	One MD dislikes RNs telling him when to reassess but does not block new system. Improved reassessment time (see Figure 3 run chart)	Repeat cycle
Idea 3, Cycle 3	Repeat cycle	Tested on six patients	Improved reassessment time (see Figure 3 run chart).	Repeat cycle: team brainstorming and looking to continue introduction of small tests of change

6. Conclusions

This case study investigated the improvement of patient flow in Saskatoon and Regina EDs. Specifically, our study aimed to reduce both the average times and variability associated with a patient's visit to the ED.

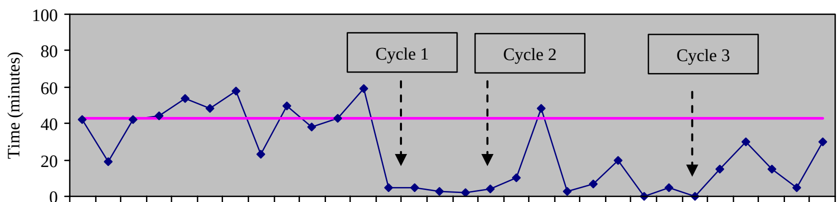
During the first phase of this project, we hired and trained nursing students in Saskatoon and Regina to conduct direct observation of patients moving through the ED. This enabled us to identify waiting and service times for key high-level ED activities. In the end, our data collectors were able to capture wait and service time data for over 1,700 patients across five facilities.

On an average, patients spend nearly five hours in the ED with about one-half of the visit devoted to waiting for the next required service to take place. For some high-level processes, wait times are substantially longer than the service times associated with delivering ED patient care. Bed ready time, the interval from ordering an inpatient bed until it is ready for occupancy, comprised the longest wait time. Other rather lengthy wait times involved the "specialist consultation" wait (the interval between requesting a specialist consultation and the moment the specialist arrives to see the patient) and "MD other" (the time between the end of a patient's previous activity and the start of an "MD other" activity, such as physician reassessment).

Owing to project constraints, we opted to investigate physician reassessment wait times at Saskatoon's RUH. We worked with quality improvement teams on a series of PDSA cycles to measure and document process improvement. We tested a variety of suggestions aimed at standardizing processes and reducing waiting time for this particular activity. The teams constructed a run chart to document their efforts – in the

1.	Time of ED physician assessment of patient:	________
2.	Blood work ordered and collected (ECG, X-ray):	________
3.	Diagnostic tests ordered:	________
4.	Treatment started as ordered:	________
5.	Last treatment completed at:	________
6.	Diagnostic tests completed at:	________
7.	Last Lab result back at:	________
ED physician notified that patient is ready for reassessment at:		________
Reminder:		
Whiteboard marked for reassessment		
Chart marked for reassessment		

Table VII. Patient ready for ED Physician Reassessment Worksheet



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Wait times	42	19	42	44	54	48	58	23	50	38	43	59	5	5	3	2	4	10	48	3	7	20	0	5	0	15	30	15	5	30
Median	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43

Figure 3. Run chart for physician reassessment time at RUH site

end, they achieved more than a 50 per cent reduction in MD reassessment waiting times. Moreover, these improvements required minimal materials cost and no additional staff. Along with other projects highlighted in the literature review, our efforts represent evidence of the successful role of PDSA cycles in promoting process improvement.

The success of this quality improvement initiative occurred despite significant challenges in maintaining a smooth pace of activity. One of the key barriers was human resource capacity. We heard from staff that the RUH department is already very busy and operating at a relentless pace with not enough breaks. We found that teams were repeatedly pulled back into their regular ED duties while running PDSA cycles, leading to delays in anticipated improvement work. This happened when there was a surge in the number or complexity of acutely ill patients. Such instances occurred despite the fact that quality improvement teams were doing their work on paid staff time. As we discovered, staff in this specific ED are constantly being called into work overtime, and hence were reluctant to put in extra time to support an improvement project when the alternative was to have more time off work.

A young workforce at this site also added to the challenges of implementing quality improvement. Nearly, two-thirds of the nursing staff have been working in the ED for less than two years, while about half of the staff have been there for less than one year. These professionals are learning the basics of their job environment and may not have as much experience to reflect on how to improve care.

Possible recommendations that this ED may wish to pursue to improve overall improvement efforts would be to develop an ongoing method of measuring key wait and service times. Obtaining time values via direct observation – although necessary for this project – was quite costly and may not be sustainable in the future. Planners may wish to consider different means of integrating data collection mechanisms for quality monitoring into the daily routines of ED staff. Options to consider include automated patient tracking systems and use of radio frequency identification tags to track patient or provider movements.

Recall that one of the key barriers in ED wait time improvement is the competition for providers' time and attention in the midst of human resource constraints. We are aware of other facilities (e.g. Virginia-Mason Medical Center in Seattle, WA) that allow teams the dedicated time necessary to focus their energy exclusively on a tightly defined improvement activity. This approach still requires careful management of human resource constraints but could be one strategy to facilitate process improvement.

In terms of future directions for quality improvement, we recognize that in-patient bed-ready times represent a significant contributor to ED patient length-of-stay. Because such patients consume an ED bed, this wait time may also affect other time values such as the initial wait time. This area is ideal for the application of operations research techniques. Patients flow from the ED to different inpatient wards and are then discharged into the community, long-term care or home care, or other hospitals. Each of these different locations of care has their own queues, which in turn affect the ED. Mapping of these patient flows and simulation modelling can help to identify optimal levels of resource capacity in different parts of the system.

Another future research possibility would be to undertake PDSA process improvement cycles at one of the other EDs in which we originally collected data. Recall that we chose to focus on improving one particular high-level activity at one specific ED due to budgetary and project scope restrictions. Investigating other hospitals may help to shed light on the manner in which cultural differences between facilities impacts process improvement work.

Quality improvement can occur in the ED, but it is by no means a simple exercise. There are many opportunities to improve ED wait times, but each of these opportunities requires dedicated time, energy and management attention in the midst of competing priorities and activities. Improvement will come not with quick fixes but with ongoing, continuous attempts at improving each of the different processes of care that contribute to long wait times. We can truly echo the sentiments of Dr Les Vertesi, a renowned Canadian ED physician: "Improving the ED is like trying to change your fan belt with the engine running" (Vertesi, 2005).

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