Continuous Quality Improvement in Orthopaedic Surgery: Improving Patient Experience, Safety and Outcomes

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ABSTRACT

As the demand for accountability and transparency surrounding the supply of increasingly expensive medical services grows, healthcare providers have put continuous quality improvement (CQI) programs in place to optimize care and improve efficiencies. CQI programs that rigorously evaluate healthcare services can lead to informed decisions about the direction of planned improvements through evolving knowledge translation. Successful end products may include better patient satisfaction, improved patient-reported outcomes, highly-efficient care pathways, and overall cost-savings. There are numerous steps involved in implementing CQI programs that require collaboration and cooperation from physicians, allied health care workers, support staff and hospital management in order to achieve desirable goals. The Division of Orthopaedic Surgery at The Ottawa Hospital (TOH) has initiated a CQI program which is designed as a classic Donabedian Construct with a triple aim framework of: 1. improving care, 2. improving patient experience, and 3. lowering cost. The development of our electronic CQI database will be a key component in the 5-year (2015-2020) Strategic Plan for the Division, and is in keeping with the goal of TOH becoming a top 10% performer in quality and safety of patient care in North America. The aim of this paper is to outline our compliance with the ongoing activities required to meet clearly delineated quality metrics, and the development of the many facets of our CQI program.

RÉSUMÉ

En réponse à la demande croissante de transparence et de responsabilité concernant les services de santé dispendieux, les fournisseurs de soins de santé ont mis sur pied des programmes d'amélioration continue de la qualité (ACQ) pour optimiser les soins et l'efficience. Les programmes d'ACQ qui évaluent rigoureusement les services de santé permettent des décisions plus éclairées quant aux améliorations à apporter, grâce au transfert de connaissances. Parmi les résultats positifs de ces programmes, on peut compter une plus grande satisfaction et une amélioration des résultats rapportés par les patients, des plans d'intervention particulièrement efficients, et une réduction des coûts. De nombreuses étapes dans la mise en place des programmes d'ACQ nécessitent une collaboration entre les médecins, le personnel de soutien, les gestionnaires de l'hôpital et les autres professionnels de la santé afin d'atteindre les objectifs désirés. La Division de chirurgie orthopédique de l'Hôpital d'Ottawa a lancé un programme d'ACQ conçu selon le modèle classique Donabedian, qui poursuit un triple objectif : 1. améliorer les soins, 2. améliorer l'expérience des patients, et 3. minimiser les coûts. La création d'une base de données électronique pour l'ACQ sera une composante clé du plan stratégique de 5 ans (2015-2020) de la Division, et se conforme à l'objectif de l'Hôpital d'Ottawa de devenir l'un des plus performants en Amérique du Nord, sur le plan de la qualité et de la sécurité des soins aux patients. Le but de cet article est de décrire brièvement le développement de nombreuses facettes de notre programme d'ACQ, et notre conformité aux normes de la qualité.

BACKGROUND

Canadian healthcare organizations have been interested in continuous quality improvement (CQI) since the 1990's when a survey indicated growing awareness of the philosophy and methods of CQI in an effort to improve patient experience and safety [1]. Successful CQI initiatives modelled from commercial industry have been designed to use a structured planning approach to evaluate current healthcare processes and improve upon them to achieve the desired goals and vision [2,3]. Many such frameworks implemented recently have curtailed rising costs and proven valuable at improving patient outcomes and satisfaction [1,4,5]. In Ontario, the need for quality improvement plans have now migrated into a formal commitment, aligned with system and provincial priorities [6] brought forward by the Health System Funding Reform of April 2012 as part of Ontario's Action Plan for Health Care.

Given this mandate, The Ottawa Hospital (TOH) has stated that it aims to maintain and improve patient care while operating with-

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in a budget, leading to better patient experience, better quality healthcare at less cost, and healthier populations. In line with this initiative, the Division of Orthopaedic Surgery established a five year (2015-20) Strategic Plan in which a CQI program designed to improve the quality of care was to be implemented. The purpose of this paper is to provide an outline of the key components of our CQI program as well as review early challenges and progress thus far in its implementation.

Quality Improvement in Healthcare

CQI in the context of healthcare was originally promoted by Donabedian, Berwick, and Jencks and Wilensky and represents a systematic approach to making changes that lead to better patient outcomes and stronger health system performance [5]. While there is agreement from an industry point-of-view that quality embodies notions of efficiency, effectiveness, and consumer satisfaction, the fact remains that in healthcare, definitions of quality can be subjective [7,8]. According to the Institute of Medicine [9], quality healthcare should be: 1. safe, 2. effective, 3. patient-centered, 4. timely, 5. efficient, and 6. equitable. Importantly, quality does not necessarily improve by spending more money; in fact, quality could be a means to save money, as better coordinated care can lead to lower complication rates, shorter lengths of stay, reduced readmissions, and reduced use of health services after surgery [10]. Furthermore, technological advances make it possible for these improvements to be real and systematic, and can provide safer care with fewer errors and better adherence to proven best practices. Regardless of definition, with the increased attention focused on optimizing healthcare value and patient outcomes, quality improvement practices have become increasingly mainstream [11].

Quality Improvement in the Division of Orthopaedic Surgery at TOH

Over the last four years the Division of Orthopaedic Surgery at TOH has been engaged in numerous hospital-led quality initiatives, each of which has resulted in improvements at a variety of levels. With a focus on improving safety culture and integrating safety practices into clinical units, the Comprehensive Unit-Based Safety Program (CUSP) was developed to address patient risks identified by frontline providers and, with hospital executive support, optimize physician buy-in and implement a safety culture [12]. Surgical site infections (SSI) in both orthopedic and neurosurgical spine patients have been the primary focus of CUSP to date. Initiatives that have been disseminated hospital-wide include: 1. patient pre-warming and 2. intra-operative time-out for operative cases exceeding 4 hours; the latter consisting of antibiotic redosing, patient positioning check, wound irrigation, retractor repositioning, and surgeon glove change. Specific to spine patients, the increased utilization of tranexamic acid, standardization of post-operative dressings and the auditing of spine surgeons' infection-prevention strategies have also been addressed through this initiative. To monitor these changes, the National Surgical Quality Improvement Program (NSQIP) data set collected at TOH was used. Historical spine SSI rates reported as a requirement of TOH's NSQIP involvement, representing a 20% sample, were 4.0% and 5.3% for neurosurgical and orthopedic spine patients respectively from 2010-2015. As of January 2016, TOH has utilized the NSQIP procedure-targeted process for 100% sampling of targeted procedures, which include all spine cases. The resultant combined orthopedic and neurosurgical spine SSI rate of 2.4% provides a more accurate overall picture, making it easier to assess the success of interventions that have been put in place.

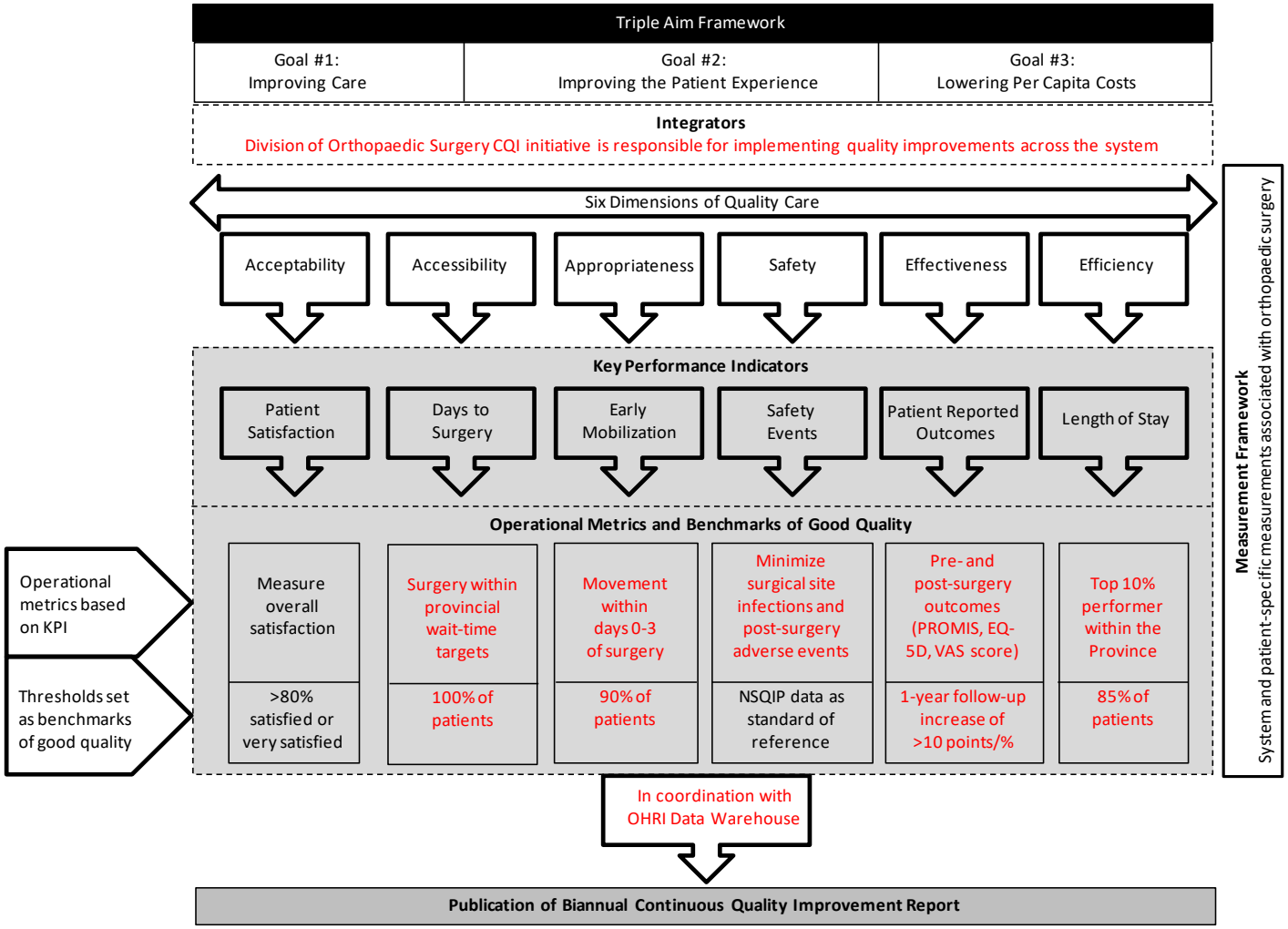
In addition, to improve patient safety as well as facilitate both physicians' and allied health engagement, the Patient Safety Learning System (PSLS) was introduced as a self-reporting tool available online through the hospital portal. A review of approximately 80 of the Division of Orthopaedic Surgery PSLS events was carried out between November 2015 and November 2016. The most common themes identified were: 1. inadvertent patient injury (at the time of surgery, during dressing changes), 2. positioning issues (excess pressure over time, sudden loss of support—occasionally leading to patient injury) and, 3. medication errors (incorrect, not ordered, records not completed).

However, there was a lack of coordination in connecting these initiatives, no grading for the severity of the events putting patient safety at risk, as well as limited physician engagement. Hence in 2016 we commenced documenting and requiring physicians to report adverse events (AEs), which are then analysed for themes and discussed with members of the Division of Orthopaedic Surgery as part of Morbidity and Mortality rounds for consideration of potential improvements at the Divisional level and within individual Clinical Practice Units (CPUs), which are subspecialty areas of the orthopaedic surgery umbrella. With regards to AE reporting, we have introduced the OrthoSAVES tool, which we previously validated against surgeon-driven reporting and manual chart reviews [13]. In total, from January 2016 to November 2016, 372 AEs were reported in 266 patients, with 106 patients reporting 2 or more AEs. AEs were graded based on the validated Clavien-Dindo Classification [14], originally adapted by Sink et al. in 2011 [15]. There were 266 Grade 1 or Grade 2 AEs, of which urinary tract infection (UTI) and delirium were most prevalent, and 53 Grade 3 AEs, of which SSIs were most common. In an effort to decrease our reported AEs, we have created a urology working group that will begin to implement the methods and protocols suggested by the Division of Urology with the aim of reducing UTI occurrence by a minimum of 50%. In addition, specific educational sessions and feedback to staff are now provided at monthly patient safety and CQI meetings and resident rounds.

We are currently working to have the reporting/monitoring of AEs reach a compliance rate of greater than 80%.

Electronic CQI Database for Healthcare Outcomes

As part of our Strategic Plan (2015-2020), we are developing our comprehensive Division-wide electronic CQI database [16]. To serve as the starting point for our quality improvement initiative, the Donabedian Construct [5,17] was utilized to distinguish among the following three aspects of quality in healthcare: 1. the structure of the health care system, 2. the processes of care, and 3. the outcomes of care. CQI starts by identifying areas of improvement using health care outcome indicators. To define these outcomes, the Triple Aim framework of patient health outcomes, the patient experience, and per capita costs was then filtered into the Six Dimensions of Quality Care. From there, assessable and operational quality metrics were outlined (**Figure 1**).



Note: The red font represents Division of Orthopaedic Surgery CQI Program elements.
KPI: Key Performance Indicator; EQ-5D: EuroQol 5 Dimension Quality of Life; VAS: Visual Analogue Scale; NSQIP: National Surgical Quality Improvement Program

Figure 1: Donabedian Construct Diagram (Adapted from [17]).

The core tenets of our electronic CQI database include: 1. the collection of data containing clinically relevant patient variables that allow assessment of clinical outcomes, 2. feedback of outcomes data to surgeons with risk adjustment and benchmarking of the data, and 3. implementation of appropriate interventions to promote reduction in wasteful and inefficient variation in care, while simultaneously improving processes and performance. Patient-centered outcomes typically include self-perceived quality of life, physical functioning and overall satisfaction with care and outcomes [18]. In order to improve outcomes, services provided and resources used also need to be recorded, analyzed and benchmarked in conjunction with the dynamics of the healthcare pathway in which patients interact. One recent success story in Canada with respect to integrating a CQI program for hip and knee replacement surgical care was presented by Marshall et al. [5]. Working collaboratively, multidisciplinary experts managed to embed the Triple Aim framework and six dimensions of quality care into everyday practices in clinics across Alberta. As of publication, 83% of surgeons were participating in the CQI program, representing 95% of the total volume of hip and knee surgeries. Biannual reports were also providing feedback to improve care processes, infrastructure planning, and patient outcomes.

In regards to our electronic CQI database, we have completed the design element and have started the implementation phase. Our CPUs have been developed and are both condition and anatomic specific: Foot and Ankle, Orthopaedic Oncology, Spine, Sports Medicine and Knee Preservation, Upper Extremity (Hand and Wrist; Shoulder and Elbow), Adult Reconstruction, and Trauma. Within every CPU, the initial focus will be to collect data on the five most prevalent and/or costly conditions (**Table 1**). For example, in the Foot and Ankle CPU, this will be: 1. Ankle Osteoarthritis; 2. Ankle Osteochondritis Dissecans; 3. Complex deformity (pes planus/pes cavus); 4. Achilles rupture and tendinopathies; and 5. Hallux disorders. Afflicted patients meeting entry criteria with one of these five conditions who require surgery will be enrolled into our electronic CQI database facilitated through a tailor-made software platform. From there, individual patients and healthcare performance will be assessed and followed during their journey at TOH in accordance with the detailed workflow diagrams set out in **Figures 2a-2d**.

When implementing such a large scale electronic CQI database, the time and personnel involvement is significant. This either has involved or will continue to require biweekly to weekly meetings with a large number of stakeholders including members of the Patient Safety and CQI committee; heads of the CPUs; orthopaedic surgeons; CQI assistants; research assistants and coordinators; orthopaedic administrators; orthopaedic clinic and ward clerks and nurses; and patients themselves. In addition, key members from the hospital administrative standpoint that have been involved and must be continually consulted include Contracting

Table 1: Clinical practice units in the Division of Orthopaedic Surgery at TOH and their top five conditions of interest.

Clinical Practice Unit	Top Conditions of Interest
Foot & Ankle	Ankle osteoarthritis Ankle osteochondritis dissecans Complex deformity Achilles rupture and tendinopathies Hallux valgus and osteoarthritis
Orthopaedic Oncology	Soft tissue sarcoma Bone sarcoma Metastatic bone disease Benign bone tumour Benign sarcoma
Spine	Cervical myelopathy/radiculopathy Lumbar spinal stenosis Lumbar disc herniation/radiculopathy Spondylolisthesis Scoliosis/Kyphosis
Sports Medicine & Knee Preservation	Meniscal Tear Ligament Tear Limb deformity Hip labral tear Articular cartilage injuries
Upper Extremity – Hand & Wrist	Scaphoid non-union Scapholunate advanced collapse Triangular fibrocartilage complex tear Scaphoid non-union advanced collapse Carpometacarpal osteoarthritis
Upper Extremity – Elbow & Shoulder	Shoulder Arthritis Shoulder Instability Rotator Cuff Tear Elbow arthritis Elbow contracture
Adult Reconstruction	Hip and knee arthritis Instability of hip and knee replacement Aseptic loosening of hip and knee replacement Septic failure of hip and knee replacement Peri-prosthetic fracture
Trauma	Distal radius fracture Tibial shaft fracture Proximal femur fracture Ankle fracture Acetabular and pelvic fractures

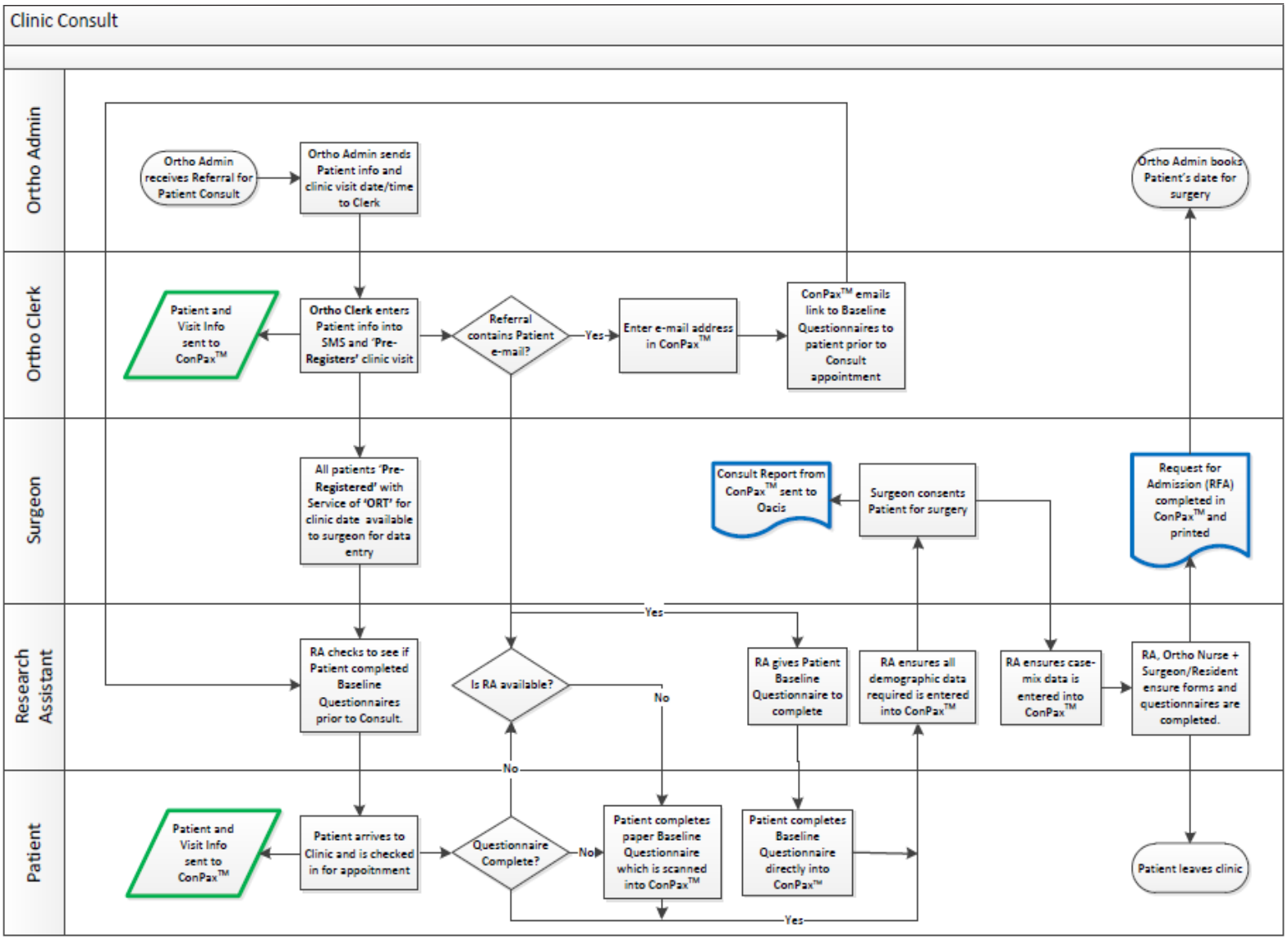


Figure 2a: Workflow of Orthopaedic CQI Program: Pre-operative Consultation Clinic Appointment.
SMS: Corporate SMS Registration System; RA: Research Assistant; ConPax: CQI Software Program; Oacis: TOH Electronic Medical Records

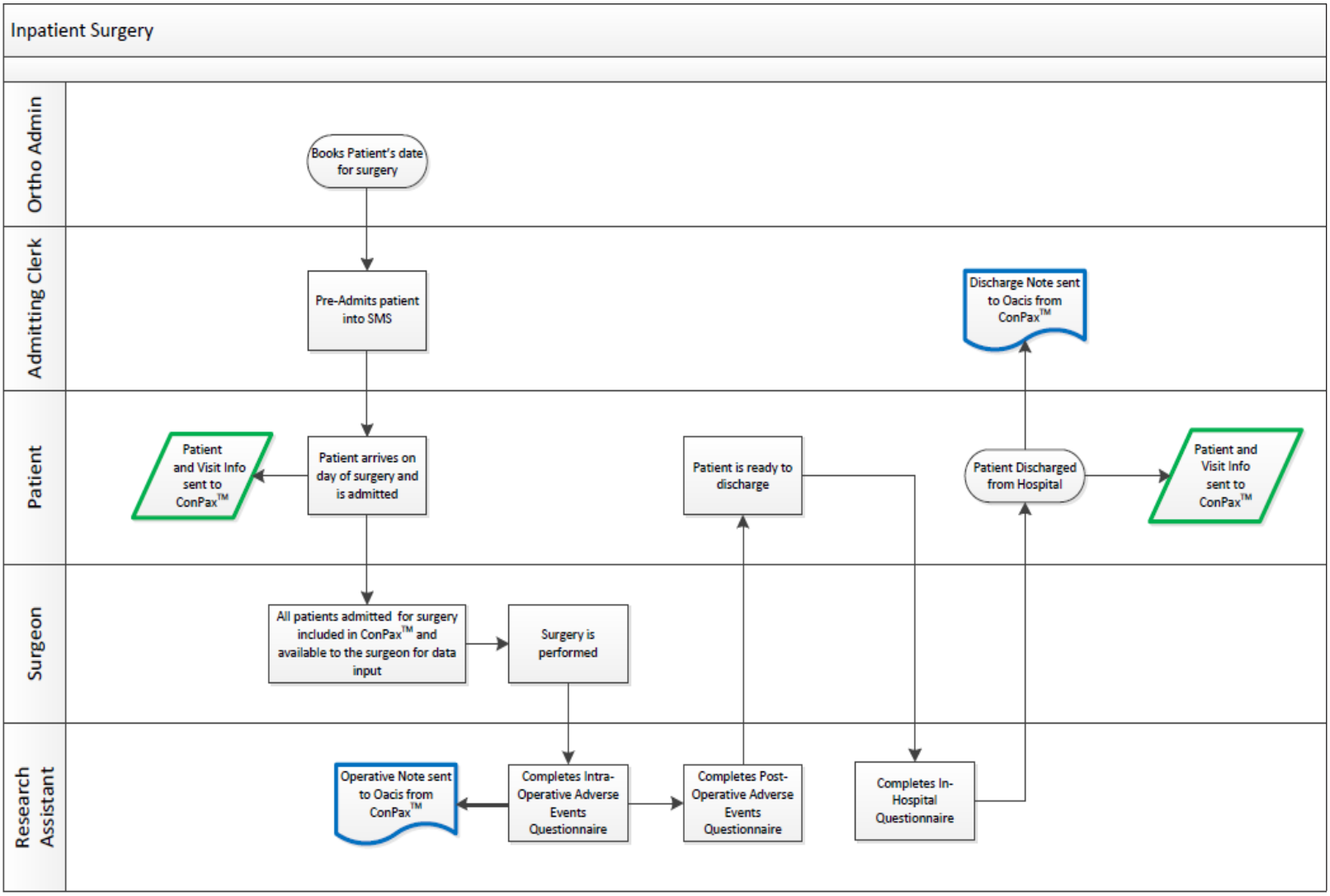


Figure 2b: Workflow of Orthopaedic CQI Program: Inpatient Surgery with Hospital Admittance.
SMS: Corporate SMS Registration System; ConPax: CQI Software Program; Oacis: TOH Electronic Medical Records

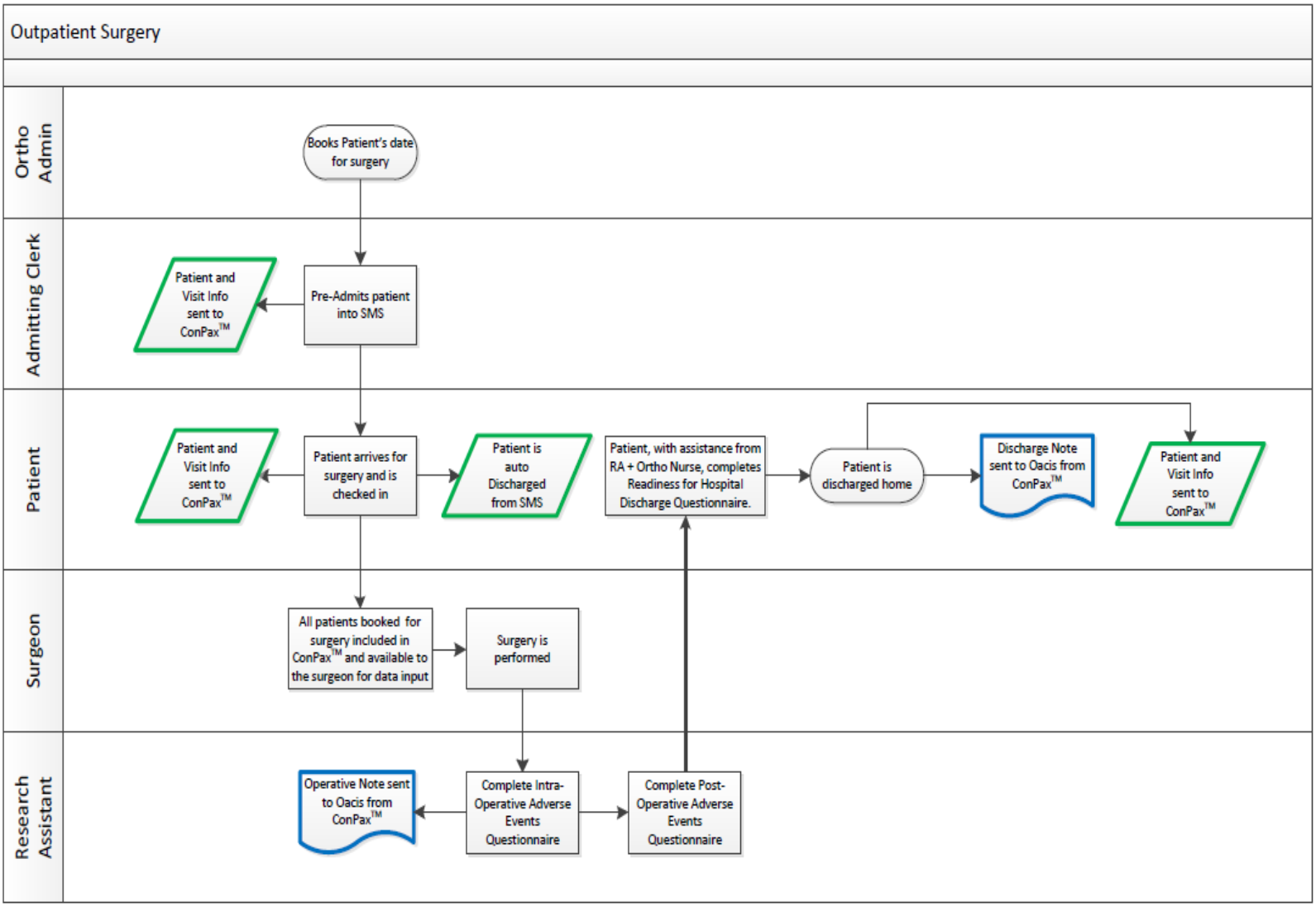


Figure 2c: Workflow of Orthopaedic CQI Program: Outpatient Surgery with Same-day Discharge.
SMS: Corporate SMS Registration System; RA: Research Assistant; ConPax: CQI Software Program; Oacis: TOH Electronic Medical Records

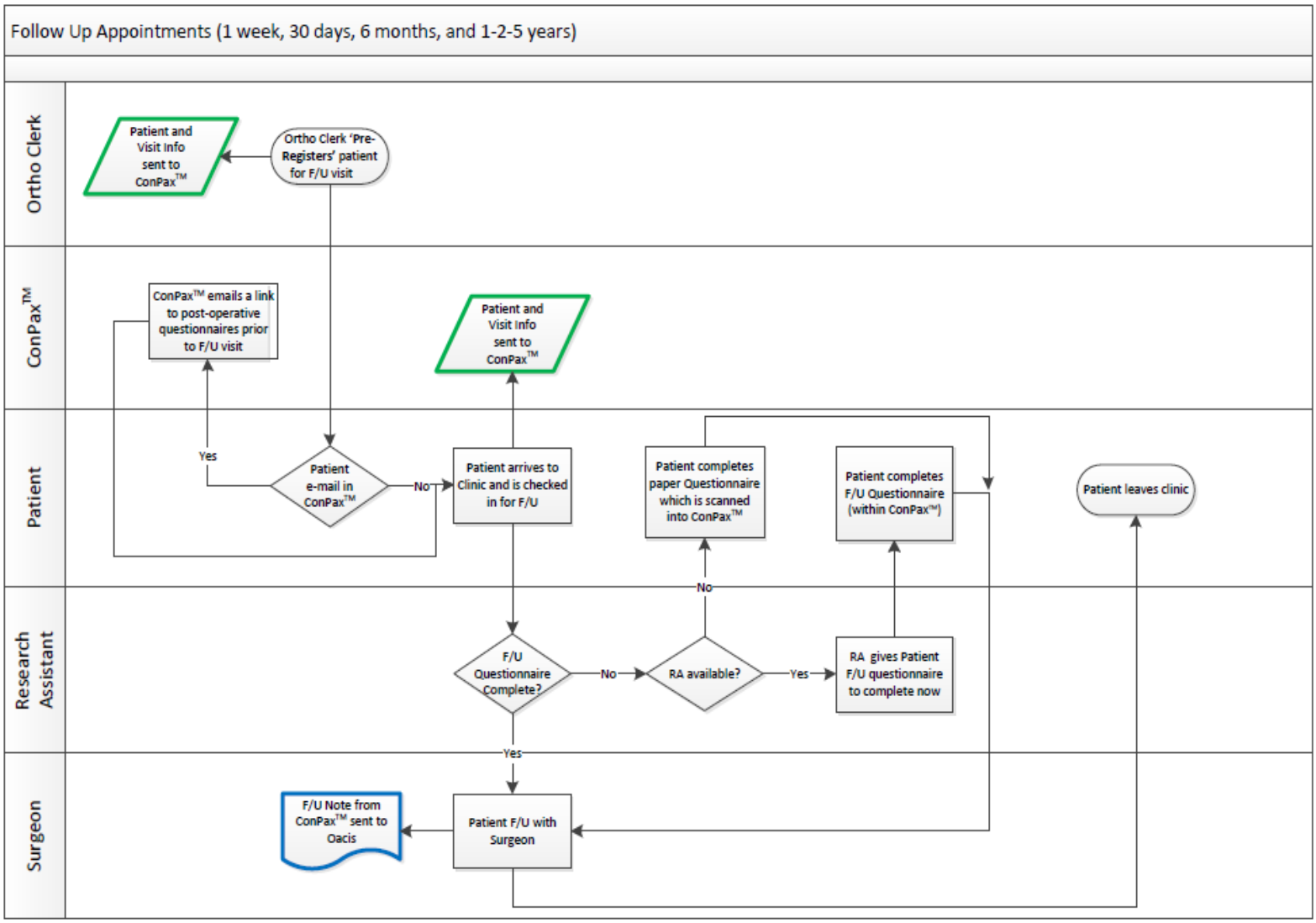


Figure 2d: Workflow of Orthopaedic CQI Program: Post-operative Follow-up Clinic Appointment.
SMS: Corporate SMS Registration System; RA: Research Assistant; ConPax: CQI Software Program; Oacis: TOH Electronic Medical Records; F/U: Follow-up

and Procurement; Information Services Steering Committee and Program Managers; and members of the Information Technology team. Finally, the electronic CQI database software platform must have the capacity to be tailored to the hospital IT system as well as each individual CPU.

At each stage of the respective workflow, data for CQI purposes will be collected and analyzed in order to produce quarterly reports designed to provide the Division of Orthopaedic Surgery with an overview of our performance, and indicators as to how to improve the quality of our medical care. Critical feedback from the reports will help to provide a more sensible distribution of tasks associated with data collection and data entry in order to enhance physician and staff engagement by limiting their time on keyboard while spending more time with their patients [19]. Of note, there is currently not enough evidence to be able to determine what incentive structure might "work" in a particular health-care system. Future efforts will necessitate the need for strong physician leadership and engagement in helping to ensure an optimal care team that is as patient-centered as possible. In that regards, gaining a better understanding of the challenges/barriers for physician engagement is a critical step when implementing a CQI program.

CQI Program: Studying Processes – Most Responsible Physician (Example Project)

In addition to obtaining valid patient outcome data, the assessment of health care processes is a critical aspect of any CQI program, where evaluation of health care services is necessary in order to identify and correct deficiencies and ultimately improve outcomes. A commonly documented deficiency lies in the communication between physicians and other healthcare providers. Breakdowns in communication have been cited as one of the leading causes of AEs that can threaten the safety of a patient [20-22]. Poor communication can lead to confusion about the identity of the most responsible physician (MRP). As explained by the Canadian Medical Protective Association, the MRP is "the physician who has overall responsibility for directing and coordinating the care and management of an individual patient at a specific point in time. They are also responsible for making a record of any interaction; furthermore, this record should be legible." [23]. Consequently, proper identification of the MRP is important to ensure that patients, their families and other healthcare personnel know who is caring for them, how they are responding to the medical treatment, and who is responsible for making critical decisions—sometimes on short notice in acute situations.

To address this critical issue, TOH implemented the Elizabeth and Matthew Policy in 2014 to outline the standard of communication and documentation concerning the MRP and patient care both for in-hospital and ambulatory care. Although the Elizabeth and Matthew Policy is local to TOH, other hospitals across Canada and the United States have similar policies outlining MRP expectations. In order to assess the effectiveness of this policy as well as determine the level of physician engagement or compliance, the Patient Safety and CQI committee set out to evaluate two key questions: 1. Does the MRP provide proper documentation of their encounters with a patient within 24 hours of admission, daily throughout the acute treatment phase, and document discharge instructions?, and 2. What is the accuracy of MRP identification? Findings from this study will be enacted upon in our CQI program in terms of physician identification and responsibility for data completion.

Table 2: Presence of notes, note legibility, and signature legibility at 24-hour post-admission and on post-operative days (POD) and at discharge (D/C).

Inpatient Time Period					
MRP only	24-hour note	POD 1	POD 2	POD 3	D/C
Presence of notes	62/320 (19.4%)	32/229 (14.0%)	11/156 (7.1%)	4/110 (3.6%)	23/320 (7.2%)
Note legibility	23/62 (37.1%)	2/32 (6.3%)	0/11 (0%)	0/4 (0%)	6/23 (26.1%)
Signature legibility	5/62 (8.1%)	0/32 (0%)	0/11 (0%)	0/4 (0%)	0/23 (0%)
MRP and Trainees	**24-hour note**	**POD 1**	**POD 2**	**POD 3**	**D/C**
Presence of notes	310/320 (96.9%)	209/229 (91.3%)	141/156 (90.4%)	101/110 (91.8%)	227/320 (86.6%)

MRP: most responsible physician; POD: post-operative day; D/C: discharge

Retrospective Chart Audit

A retrospective chart audit was completed for a random sample of 320 out of 1891 admitted elective orthopaedic surgery patients from January to December 2015. Two independent reviewers examined patient charts and documented presence of notes, note legibility, and signature legibility for eight orthopaedic MRPs within 24 hours of admission, during weekday hospitalization on post-operative days (POD) 1, 2, and 3, and prior to discharge (**Table 2**). Fewer than 20% of inpatients had notes written by the MRP in their chart during their inpatient course. When there were notes in the patient's chart, fewer than 40% were legible. Furthermore, less than 10% of signatures were legible. When resident, fellow, and medical student notes were considered as valid documentation, numbers improved dramatically: within 24 hours of admission, 96.9% of patients had a note in their chart, 91.3%, 90.4%, 91.8% had notes present at POD 1, 2, and 3 respectively, and 86.6% had notes at discharge. These findings are helpful in policy design as they question whether the Elizabeth and Matthew Policy should be modified to permit MRP counter-signature of notes written by trainees rather than those written by the MRP themselves (which are frequently illegible).

Prospective Real-time Audit

Two independent reviewers evaluated MRP identification in 190 patients between June and August 2016, by reviewing: 1. the chart binder label of the patient; 2. the white board; and 3. Oacis (TOH's electronic medical records). At first review after admission, the MRP was correctly identified 36.3%, 44.7%, and 93.2% of the time on the chart binder label, white board, and in Oacis, respectively. At review any time post-admission, the MRP was correctly identified 36.3%, 66.8%, and 97.4% of the time on the chart binder label, white board, and in Oacis, respectively (**Table 3**). Together, these results demonstrate that MRP identification can be problematic with multiple sites of recording, and that errors on chart binder labels and white boards can persist throughout the admission. Identification of MRP via chart binder label and the white board also highlighted that there was a significant learning curve in the first few months of implementing a new comprehensive orthopaedic service wherein all surgeries regardless of elective or emergency were converted under one MRP on a week-to-week basis.

Table 3: Correct identification of most-responsible physician (MRP) at first review after admission compared to at any time after admission on the orthopaedic surgery inpatient unit.

Correct Identification (%) at ay time after	
Source	Total
Chart Binder Label	69/190 (36.3%)
White Board	85/190 (44.7%)
Oacis	177/190 (93.2%)
Correct identification (%) at any time after	
Source	Total
Chart Binder Label	69/190 (36.3%)
White Board	127/190 (66.8%)
Oacis	185/190 (97.4%)

Oacis: TOH electronic medical records

These two set of results—retrospective chart audit vs. prospective real-time audit—provide key insights into a potential barrier for CQI program implementation. Physician engagement remains a challenge for proper documentation, as well as issues with processes within the institution which can put patient safety at risk in the acute setting.

FUTURE DIRECTIONS

Canadian physicians are becoming increasingly accountable to the public for both the cost and quality of the care they provide. All physicians, not just orthopaedic surgeons, must become active participants in the quality movement by understanding the basic principles of CQI and how they apply to patient care. The best chance of improving overall care is through the adoption of systems that improve coordination and continuity. The Division of Orthopaedic Surgery at TOH has been a leader in embracing CQI initiatives as a priority. Only through collaboration and integration can healthcare incorporate a culture for improving quality and patient safety.

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