ORIGINAL ARTICLE

MAYO CLINIC PROCEEDINGS:
INNOVATIONS, QUALITY & OUTCOMES

MAYO CLINIC

Expanding the Role of the Surgical Preoperative Evaluation Clinic: Impact on Risk and Quality Outcome Measures

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Abstract

Objective: To prove that inpatient-adjusted surgical risk and quality outcome measures can be considerably impacted by interventions to improve documentation in the preoperative evaluation (POE) clinic.

Patients and Methods: We designed a quality improvement project with a multidisciplinary team in our POE clinic to more accurately reflect surgical risk and impact expected surgical quality outcomes through improved documentation. Interventions included an improved patient record acquisition process and extensive POE provider education regarding patient comorbidities' documentation. For patients admitted after their planned operations, POE clinic comprehensive evaluation notes were linked to inpatient History and Physical notes. High complexity patients seen from October 1, 2018 to December 31, 2018 were the preintervention cohort, and the patients seen from January 1, 2019 to December 31, 2019 were the postintervention cohort.

Results: The primary outcome measures included the total number of coded diagnoses per encounter and the number of coded hierarchical condition categories per encounter. The secondary outcomes included the calculated severity of illness, risk of mortality, case-mix index, and risk-adjustment factor. Postintervention results show statistically significant increases in all primary outcomes with a $P<.05$. All secondary outcome measures reported positive change.

Conclusion: Our interventions confirm that a comprehensive POE and thorough documentation provide a more accurate clinical depiction of the preoperative patient, which in turn impacts quality outcomes in inpatient surgical settings. These results are impactful for direct and indirect patient care and publicly reported hospital and provider level performance data.

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Traditionally, a preoperative assessment focused on preanesthetic investigations and medication optimization was completed by a primary care provider. Gradually, over the past 2 decades, dedicated preoperative evaluation (POE) clinics have been deployed by health systems to improve perioperative quality.[1] The POE clinics have shown marked increases in surgical volume, improved patient flow, reduced unnecessary consultations and testing, reduced length of stay, and reduced cancellations through process optimization.[2-4] Observed patient outcomes have also benefited with improved satisfaction and significant decreases in postoperative complications, such as wound infections and mortality.[2,4]

In 2010, hospitals were mandated to report surgical quality outcome measures using standardized web access by the patient protection and affordable care act, commonly referred to as the affordable care act.[5] These metrics impact decisions by consumers (patients), purchasers, health plans, providers, and policy makers.[6] Providers and institutions alike have traditionally expressed reservations concerning publicly available quality data over concerns of increased surgeons' reluctance to operate on the highest risk cases.[7-9] Complex methodologies were deployed to risk-adjust patients to ensure fairness and validity in the reported surgical quality outcomes, such as perioperative morbidity and mortality.[10,11]

Risk adjustment for hospital outcomes is commonly employed by large payors, including The Centers for Medicare and Medicaid Services (CMS), Medicare advantage plans, and other public and private insurers. Furthermore, various ranking and rating companies use risk adjustment to ensure fair and accurate comparative quality outcome measures.[12-14] The breadth of factors used in risk adjustment is extensive, encompassing 9,700 International Classification of Diseases, Tenth Revision, Clinical Modification codes. These codes map to one or more of the 87 hierarchical condition categories (HCC) used in the CMS-HCC risk-adjustment model. Documented HCC codes are also used to formulate a risk-adjustment factor (RAF) to estimate the overall risk of CMS plan beneficiaries, allowing CMS to more accurately reimburse organizations on the basis of differences in expected costs.[15]

Traditionally, providers have used tangible clinical outcomes as the predominant marker of the quality of an intervention.[16] Many providers fail to consider that bedside outcome measures alone, without risk adjustment, would considerably bias results, akin to failing to randomize a clinical trial adequately. In the quality and outcome measures domain, "randomization" is achieved by risk-adjusting the population of a provider or health system by compiling and coding all comorbid diagnoses.[17] Providers, particularly those in POE clinics, must broaden their definition of quality and outcome measures to include risk-adjustment factors, as these have important implications for providers, facilities, and patients.[6] These factors depend directly on the coded data ascertained during a comprehensive POE visit.

We designed a quality improvement project to report that in addition to the improved observed patient and hospital outcomes noted above, process improvements targeted at the POE clinic could impact risk-adjusted surgical quality data through the comprehensive identification, evaluation, validation, documentation, and codification of patient comorbidities.[10,11]

METHODS

The POE Clinic

Mayo Clinic in Florida (MCF) is a quaternary care facility functioning as a destination surgical center. MCF surgical teams have the ability to perform highly specialized surgical and procedural interventions for an extremely complex patient population, usually patients referred from other medical systems. Because of this referral heterogeneity, patient detailed clinical information is usually not immediately available before elective operation, therefore patients are referred for an assessment in the POE clinic. Almost every patient scheduled for a surgical intervention at MCF undergoes a phone interview with a POE nurse, followed by an in-person evaluation by a POE provider. This process will clarify the previous medical and surgical history and optimize the patient's clinical conditions before the planned procedure. Patients who require urgent or emergent procedures are admitted directly to the hospital and do not use the POE structure, they were not included in the analysis.

The provider staffing team includes internal medicine trained physicians, anesthesiology trained physicians, and advanced practice providers. The expectation of inpatient surgical services was to link or reference the outpatient POE consult documentation using a history and physical update at the time of admission and procedure. This updated note that included the POE documentation would become the hospital's surgical history and physical note, ensuring that all the comorbidities captured by the POE providers would be accounted during hospital documentation.[18]

During the fourth quarter (Q4) of 2018, a small team, including physician advisors and clinical documentation integrity (CDI) specialists, compiled the baseline POE clinic data and met to analyze the surgical risk measures and outcomes. We observed a discrepancy in post-surgical patients' complexity on the basis of clinical assessment and their reported surgical risk metrics. After the initial review, the team determined that this gap is because of deficiency in the initial comorbidities' documentation. The project aim was to increase the average volume of HCC conditions documented per POE encounter by 20% without adversely impacting the POE physician's perception of record review efficacy. Because POE clinic was involved with this initial documentation, the team looked for focused interventions in the POE clinic that had the

potential for quality improvement in the domain of expected surgical outcome measures.

Later that quarter, a multidisciplinary research team including physician advisors, inpatient CDI specialists, POE clinic providers, POE clinic staff, nurses, and administrators was formed to formally assess the POE clinic processes and the comorbidity capture of the post-visit medical record. This team met on a regular basis using the data-driven quality improvement tool known as the DMAIC (define, measure, analyze, improve, and control) process.[19] By using the voice of customer tools, the team surveyed POE clinic providers regarding their perception of the POE clinic processes. Two high impact interventions identified by the team to improve the completeness and accuracy of the medical record are detailed below.

Educational Intervention

The first major intervention leveraged was educational and was initiated during the first quarter (Q1) of 2019. A gap in quality was identified related to POE clinic providers' understanding of the importance of complete and accurate documentation, relevant coding rules, and the fundamentals of surgical risk stratification. The educational intervention was multifaceted and included formal and informal lectures, 1 medical grand round, and the provision of educational materials (EM), such as handouts provided by the site physician advisor to all POE providers. The EM were developed using outpatient CDI resources and modified or reformatted for visual simplicity. As a reinforcement, additional supporting EM were placed in provider areas where documentation occurred. The EM included signage on workspace monitors and pocket-sized information cards. All EM emphasized the importance of complete and accurate documentation, including examples of greater specificity for common diagnoses such as diabetes mellitus, heart failure, and chronic kidney disease. The patient problem list was updated, and comorbidities were addressed in the POE consultation note. Educational interventions spanned the entire 12-month intervention period, with at least monthly touch points performed by the campus physician advisor.

Outside Record Management

The second major intervention addressed gaps in quality identified by the multidisciplinary team during the analysis phase of DMAIC with the POE clinic process surrounding receipt, review, and the electronic filing of outside medical records (OMRs). As a quaternary referral center, important patient information related to their comorbid conditions was located in these documents. This intervention was initiated during Q1 of 2019. To ensure receipt of important OMRs, 2 POE clinic nurses were reassigned to ensure outside providers faxed, mailed, or electronically uploaded the OMRs before the patient's POE visit. To address inefficiencies related to reviewing scanned outside materials, the health informatics department was educated on how to identify high priority records, such as cardiac studies and radiology reports, in the electronic medical record (EMR). To address access to OMR issues, one-on-one training was provided to POE providers related to EMR navigation, utilization of OnBase technology (Hyland Software, Inc) (repository for OMRs), and efficient location of OMRs with likelihood of containing important comorbid diagnoses.

Outcome Measures

All measures were collected prospectively. Primary outcome data were reported monthly and included the total number of diagnoses coded per POE encounter (DCPE), and the number of HCC diagnoses codes documented per POE encounter (HCCPE). Secondary outcome data were obtained quarterly and included the case-mix index (CMI), number of documented comorbid conditions (CCs), calculated severity of illness (SOI), risk of mortality (ROM), and RAF.

Statistical Methods

The preintervention period for all outcome measures was defined as the 3 months that preceded the intervention, which was Q4 of 2018. The postintervention period for all outcome measures was defined as the following 12 months of 2019 (Q1-Q4). Primary outcome measures were assessed for statistical significance using the Wilcoxon rank sum test; $P<.05$ was considered statistically

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TABLE 1. Primary Outcome Measures: Median DCPE and Median HCCPE[a]

Intervention	Preintervention	Postintervention[b]			
Period	Q4 2018	Q1 2019	Q2 2019	Q3 2019	Q4 2019
Encounters	579	367	400	360	388
DCPE	2 (1-17)	2 (1-17); P=.030	7 (1-22); P<.001	8 (1-30); P<.001	8 (1-27); P<.001
HCCPE	0 (0-6)	1 (0-11); P<.001	1.5 (0-12); P<.001	2 (0-16); P<.001	2 (0-14); P<.001

[a]Abbreviations: DCPE, number of diagnoses coded per preoperative clinic encounter; HCCPE, number of hierarchical condition categories coded per preoperative clinic encounter; Q1, the first quarter; Q2, the second quarter; Q3, the third quarter; Q4, the fourth quarter

[b]Each postintervention measures were compared against the preintervention measures from Q4 2018.

significant. All secondary measures were assessed by defining the percent change from Q4 2018.

RESULTS

Primary Outcome Measures

Table 1 below details the following information and displays it graphically (Table 1, Figure).

Encounters

There were 579 POE encounters during the preintervention period in Q4 2018. During the postintervention period, there were 367 POE encounters included in Q1 2019, 400 in the second quarter (Q2) 2019, 360 in the third quarter (Q3) 2019, and 388 in Q4 2019.

Number of Diagnoses Coded Per POE Encounters

For the preintervention period in Q4 2018, the median number of DCPEs was 2 (range 1-17). During the postintervention period, the median number of DCPEs was 2 (range 1-17) with P=.03 in Q1 2019, 7 (range 1-22) with P <.001 in Q2 2019, 8 (range 1-30) with P<.001 in Q3 2019, and 8 (range 1-27) with P<.001 in Q4 2019.

Number of Hierarchical Condition Category Diagnoses Codes Documented Per POE Encounters

For the preintervention period in Q4 2018, the median number of HCCPE was 0 (range 0-6). During the postintervention period, the median number of HCCPEs was 1 (range 0-11) with P<.001 in Q1 2019, 1.5 (range 0-12) with P<.001 in Q2 2019, 2 (range 0-16) with P<.001 in Q3 2019, and 2 (range 0-14) with P<.001 in Q4 2019.

Secondary Outcome Measures

Postintervention secondary outcome measures were compared by assessing the percent change from the preintervention data for CMI, CCs, SOI, ROM, and RAF with Q4 2018. The quarterly CMI for the postintervention period increased 11%, 11%, 10%, and 10% for Q1-Q4 2019 compared with baseline, respectively. Quarterly CCs for the postintervention period increased by 9%, 9%, 16%, and 16% for Q1-Q4 2019 compared with baseline, respectively. Quarterly SOI for the postintervention period resulted in an increase of 5%, 5%, and 10% for Q1-Q3 2019, respectively; the SOI did not change for Q4 2019 compared with Q4 2018. Quarterly ROM for the postintervention period resulted in an increase of 7%, 9%, 11%, and 6% for Q1-Q4 2019, respectively. Finally, the quarterly RAF for the postintervention period resulted in an increase of 10%, 13%, 10%, and 19% for Q1-Q4 2019, respectively. Secondary outcome data were compiled into a table format (Table 2).

DISCUSSION

The study shows that the role of the POE clinic in including a more comprehensive assessment of the surgical patient has the potential to considerably impact surgical outcome data. The interventions at the POE clinic detailed above have translated into an improved workflow where data were systematically acquired, compiled, reviewed, assessed, documented, and coded. The POE clinic providers' education on the importance

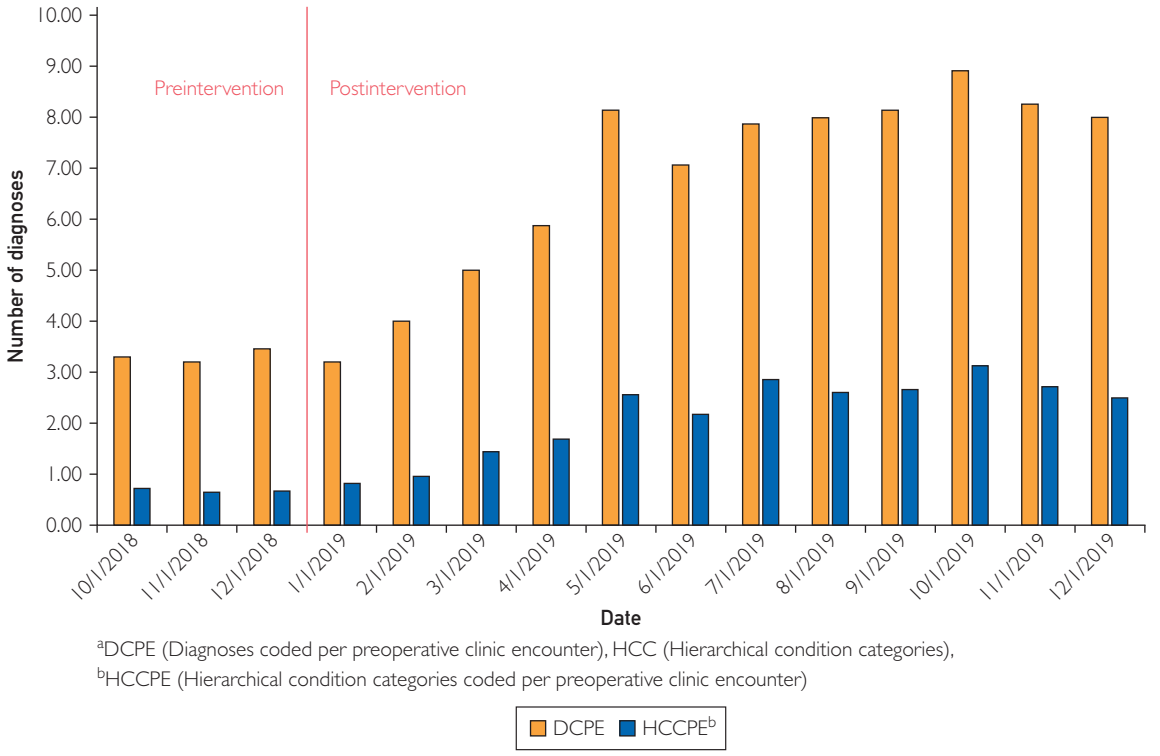

FIGURE. Number of DCPE and HCCs per preoperative clinic encounter. DCPE, number of diagnoses coded per preoperative clinic encounter; HCCs, hierarchical condition categories.

of complete, accurate, and refined diagnoses further improved their ability to capture a more complete complement of comorbid diagnoses. These interventions enabled providers to document a comprehensive assessment during a patient's visit to the POE clinic. Complete and accurate provider documentation is the essential link between clinical context and coding. Our implemented interventions have translated into a more comprehensive, detailed, and accurately coded dataset, better representing the clinical risk of the surgical patient. This risk has translated into increased risk scoring at our facility by increasing the expected risk of the surgical patient population.

The importance of accurate risk adjustment should not be understated. Any risk-adjustment model's accuracy depends on the provided data and ultimately impacts surgical quality outcomes, such as the SOI, ROM, CMI, and RAF. Providers routinely use risk adjustment at the bedside during perioperative cardiac evaluations. They leverage powerful tools to identify perioperative risk, such as the American College of Surgeons National Surgical Quality Improvement Program and the Cardiac Risk Calculator by Dr. Gupta et al.[20-24] Shared decision-making, particularly in high-risk cases, relies on a comprehensive identification and evaluation of comorbidities; perioperative risk calculations are only as valid as the information provided. Gaps in quality exist in perioperative evaluations at quaternary care centers secondary to incomplete, inadequate, disorganized, and conflicting patient data confounded by EMR inadequacies.[19] Furthermore, complete and accurate evaluations are limited in situations of low health care literacy, with statistically significantly worse outcomes reported in this population.[25,26] Identification of impactful comorbidities preoperatively can potentially improve quality measures on both fronts: improved observed clinical outcomes and avoidance of an inappropriately low predictive RAF.

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TABLE 2. Percent Change in Secondary Outcome Measures Compared With Q4 2018[a]

Date	CMI	CCs	SOI	ROM	RAF
Q4 2018	—	—	—	—	—
Q1 2019	11%	9%	5%	7%	10%
Q2 2019	11%	9%	5%	9%	13%
Q3 2019	10%	16%	10%	11%	10%
Q4 2019	10%	16%	0%	6%	19%

[a]Abbreviations: CCs, comorbid conditions documented; CMI, case-mix index; RAF, risk-adjustment factor; ROM, risk of mortality; SOI, severity of illness; Q1, the first quarter; Q2, the second quarter; Q3, the third quarter; Q4, the fourth quarter

Some have wondered if POE clinics can generate enough revenue to justify their existence. A well-designed POE clinic is supposed to add value to health care by increasing quality of care and by reducing costs.[27] The POE clinics have proven their benefits for improving patient outcomes and hospital outcomes, such as postoperative complications, length of stay, and mortality. Cost reduction linked to POE clinics was previously reported with reduction of unnecessary testing or consultations and prevention of day-of-operation cancellations.[4]

The increase in cost to the hospital after surgical procedures are impacted by patient comorbidities and by complications after those procedures. Patient comorbidities were predictive of higher hospital costs more than postoperative complications.[28] Better identification of comorbidities and documentation could lead to preemptive actions to prevent postoperative complications. Moreover, increasing the documentation of comorbidities in the POE clinic may change the diagnosis-related group and improve coding accuracy, ultimately resulting in a more accurate reimbursement for hospitals. This was previously postulated to improve reimbursement and to offset the operational costs of POE clinics.[1] This study proves that with appropriate interventions we can increase the documentation and capture of patients' comorbidities. Not only were we able to show an initial increase in documentation, but with consistent intervention, the rate of increase persisted over the following quarters, as illustrated in the Figure. This process improvement may translate into a potential downstream hospital cost reduction and increase in reimbursement; however, this remains to be investigated.

Recent advancements in artificial intelligence (AI), particularly in Natural Language Processing and Machine Learning techniques, hold promise for revolutionary changes in POE clinics' future operations and roles. The AI's ability to readily find specific information in a large volume of health records and to present it to clinicians at the time of POE visit, coupled with the ability to leverage postoperative data for early detection of complications, have been described and may revolutionize perioperative medicine. Unfortunately, the lack of centralization of patients' medical records available for AI analysis and the dependance on providers to verify and promptly document comorbidities make our research still meaningful and valuable.[29]

Limitations

The primary goal of this quality intervention was to assess the downstream quality impact of interventions focused on improving the documentation in the POE clinic. In clinical practice, surgical outcomes depend both on the observed event rate (O) and the expected event rate (E), typically quoted as the O/E ratio.[30] This study was designed to assess the impact of interventions on the expected event rate, as a variable in the risk-adjustment formula. Increasing the denominator (E) in risk calculations would mathematically reduce overall risk calculations if an assumption were made that the numerator (O) was unchanging. This study was not designed to include observed outcomes during the intervention period; therefore, the impact on overall risk is made by the assumption of a constant numerator (O).

Patient important outcomes and less palpable items, such as satisfaction and the surgical experience, are important variables that routinely factor into an overarching quality measurement. However, changes in these variables were not measured in this study.[31-33] In addition, we rely on a preintervention and postintervention comparison as we lacked an appropriate control group. Although it is plausible that patients seen during the pilot had an increase in comorbidities, it is doubtful the number of DCPE and HCCPE would increase so quickly during such a short period of time on the basis of patient population changes. Therefore, the changes in DCPE and HCCPE were attributed to the intervention and not population changes.

Our institution was able to mobilize resources to identify this documentation need, standardize the outside record retrieval, and educate POE providers. Although the quality improvement analysis may be difficult to duplicate at other institutions with limited resources, the implementation of our education and the OMRs management interventions may prove to be similarly beneficial.

CONCLUSION

After a structured quality improvement project framework (DMAIC), our team was able to recognize 2 interventions aimed at increasing the accuracy of the medical records. The use of these targeted interventions in the POE clinic presents an opportunity to comprehensively identify, document, and capture a surgical patient's comorbidities. This process will ultimately impact key reportable quality outcome data. The impact that this process will have on diagnosis-related group selection, coding complexity, and ultimately on reimbursement of hospital care and reduction of costs will need to be further studied.

POTENTIAL COMPETING INTERESTS

Given their role as Editorial Board Member, Dr. Aaron C. Spaulding, had no involvement in the peer-review of this article and has no access to information regarding its peer-review. The authors report no competing interests.

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Abbreviations and Acronyms: **AI,** artificial intelligence; **CC,** comorbid condition; **CMI,** case-mix index; **CMS,** centers for Medicare and Medicaid services; **DCPE,** diagnoses coded per preoperative clinic encounter; **E,** expected event rate; **EM,** educational material; **HCC,** hierarchical condition categories; **HCCPE,** hierarchical condition categories coded per preoperative clinic encounter; **O,** observed event rate; **OMR,** outside medical record; **POE,** preoperative evaluation; **RAF,** risk-adjustment factor; **ROM,** risk of mortality; **SOI,** severity of illness; **Q1,** the first quarter; **Q2,** the second quarter; **Q3,** the third quarter; **Q4,** the fourth quarter

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