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A Mixed-Methods Evaluation of a Collaborative-Wide Quality Improvement Project to Improve Postdischarge Venous Thromboembolism Chemoprophylaxis After Abdominopelvic Cancer Surgery

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Objective: We studied a collaborative-wide quality improvement project (CQIP) focused on improving postdischarge venous thromboembolism (VTE) chemoprophylaxis adherence. We aimed to identify patient-level characteristics associated with adherence, evaluate differences in adherence rates among participating hospitals, and assess facilitators and barriers to adherence at high- and low-performing hospitals.

Background: VTE is the most common preventable cause of death after abdominopelvic cancer surgery, yet adherence to guideline-recommended postdischarge VTE chemoprophylaxis remains suboptimal. A CQIP including audit and feedback of performance data, a toolkit, coaching calls, and best practice alerts was implemented.

Methods: Patients undergoing inpatient abdominopelvic cancer surgery at a CQIP-enrolled hospital during a 3-year study period were included. Unadjusted and adjusted rates were calculated for postdischarge VTE chemoprophylaxis adherence. High performance was defined as >10% improvement and/or ≥80% adherence. We conducted semistructured interviews and focus groups with collaborative members to identify barriers and facilitators to implementation.

Results: Postdischarge VTE chemoprophylaxis adherence increased from 51.8% (preimplementation) to 64.5% (postimplementation; $P < 0.05$). Patients who underwent urologic (odds ratio [OR], 1.76 [95% CI, 1.27–2.43]) and gynecologic procedures (OR, 3.90 [95% CI, 2.73–5.58]) were more likely prescribed appropriate VTE chemoprophylaxis compared with colorectal procedures. Eight hospitals (50%) had improvement in adherence rates, and 8 (50%) were high performers. Barriers to implementation included a lack of surgeon buy-in, technical challenges, and a lack of awareness.

Conclusions: A CQIP was associated with increased postdischarge VTE adherence rates. Different barriers exist between high- and low-performing hospitals. Future collaborative work should focus on hospital-level interventions to improve low-performer results.

Keywords: abdominopelvic surgery, chemoprophylaxis, malignancy, quality improvement, venous thromboembolism

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The authors declare no conflicts of interest.

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INTRODUCTION

Venous thromboembolism (VTE) is the most common preventable cause of postoperative death for patients undergoing surgery for abdominopelvic cancer.[1] VTE chemoprophylaxis has been shown to decrease the risk of symptomatic VTE by 70% to 80%,[2] and several randomized controlled trials have demonstrated the importance of extending chemoprophylaxis beyond the inpatient stay into the postdischarge setting.[3] Although current guidelines based on level 1 evidence recommend 28 days of VTE chemoprophylaxis,[4–7] reported adherence to postdischarge VTE chemoprophylaxis guidelines is alarmingly low. Previous work within US Veterans Administration hospitals showed postdischarge VTE chemoprophylaxis adherence rates for general, thoracic, and urologic cancer surgeries to be 10.5%.[8] Published rates of postdischarge VTE chemoprophylaxis adherence for abdominopelvic surgery patients can be even lower, ranging from 1.5% to 3.8%.[9,10]

Inpatient chemoprophylaxis barriers have been identified throughout the literature. Yang et al[11] found patient refusal and prescribing errors drove nonadherence to an

inpatient postcolectomy VTE prevention bundle within the Illinois Surgical Quality Improvement Collaborative (ISQIC), whereas nonsafety net hospitals or American Nurses Association Magnet-designated hospitals were associated with higher rates of adherence. Murphy et al[12] described how the pain from injections of certain medications and the costs of medications constitute barriers to adherence that should be considered in participatory decision-making concerning VTE chemoprophylaxis with surgical patients. In contrast to our understanding regarding adherence to inpatient VTE reduction efforts, little is known about which factors impact postdischarge outpatient chemoprophylaxis for patients following abdominopelvic cancer operations.

Towards this end, in 2016, ISQIC developed and implemented a novel collaborative-wide quality improvement project (CQIP) to improve postdischarge VTE chemoprophylaxis.[13] This CQIP provided hospitals with peer coaching, educational materials including a toolkit focused on improving care, and semiannual comparative performance reports. Our objectives were to (1) identify patient-level characteristics associated with postdischarge VTE prophylaxis prescriptions, (2) evaluate postdischarge VTE chemoprophylaxis prescription adherence rates among participating ISQIC hospitals, and (3) assess barriers and facilitators of postdischarge VTE chemoprophylaxis adherence at high- and low-performing hospitals.

METHODS

Collaborative Structure

ISQIC was established in 2014 and consists of 56 hospitals across Illinois.[14,15] ISQIC is comprised of academic, suburban, community, and small rural hospitals; each hospital has a local quality improvement (QI) team consisting of trained surgeon champions, surgical clinical reviewer nurse data abstractors, and QI leaders. ISQIC hospitals participate in the American College of Surgeons National Surgical Quality Improvement Program (NSQIP). ISQIC offers numerous QI activities including educational initiatives, comparative reports, CQIPs, and networking opportunities to coordinate and guide the implementation of QI initiatives across the collaborative[15] (https://www.isqic.org/Home/About).

Postdischarge VTE Chemoprophylaxis Process Measure

The postdischarge VTE chemoprophylaxis project is a CQIP developed for voluntarily participating hospitals with implementation starting in 2016. The surgical QI collaborative conceptual model published by Wandling et al[16] in JAMA Surgery was used to guide this CQIP (Supplement 1, see http://links.lww.com/AOSO/A475). This included 21 components to accelerate and enhance improvement and focused on 5 main "pillars": guided implementation, education, comparative reports, networking, and financial support.

Components of the postdischarge VTE chemoprophylaxis CQIP included feedback of performance data compared to other hospitals, a VTE chemoprophylaxis toolkit, coaching calls for implementation strategies, electronic health record best practice alerts, process measure updates as the initiative progressed, and focus groups and interviews. The toolkit detailed evidence for postdischarge VTE chemoprophylaxis, guideline recommendations based on the type of surgery, and charts for appropriate indications and contraindications (https://www.isqic.org/docs/postVTE/ISQIC%20Post-Discharge%20VTE%20Chemoprophylaxis%20Toolkit.pdf).

The toolkit also included strategies for improving postdischarge VTE chemoprophylaxis, including patient-centered suggestions, provider-centered suggestions, clinical decision support, recommendations for gaining hospital leadership support, and implementation strategies to address potential adherence barriers. A variety of resources were provided for each category as well, for example, a template for a "postdischarge chemoprophylaxis diary" for patients and a "discharge planning checklist" for providers.

Local surgical clinical reviewers at ISQIC hospitals determined the appropriateness of VTE chemoprophylaxis for each patient and recorded the specific duration of each prescribed chemoprophylactic agent. Local hospital data were compiled centrally at ISQIC and fed back in a semiannual report to each participating institution through a centralized auditing dashboard, so hospitals could compare their performance to other participating hospitals (Supplement 2, see http://links.lww.com/AOSO/A476). Process measure-specific components of the CQIP included indication for chemoprophylaxis, whether chemoprophylaxis was ordered at discharge, type of chemoprophylaxis ordered, and prescription duration ordered (Supplement 3, see http://links.lww.com/AOSO/A477). These data were collected and analyzed to give process measure updates to each ISQIC-enrolled institution. We defined adherence to our postdischarge VTE chemoprophylaxis measure to be satisfied if a patient was prescribed guideline-recommended VTE chemoprophylaxis for the appropriate duration. The American College of Chest Physicians guidelines, the Caprini score, and a list of acceptable medications and contraindications were included as a part of the toolkit. Each of these items was used to determine the need for chemoprophylaxis (Supplement 4, see http://links.lww.com/AOSO/A478).

Study Design and Participants

Quantitative Methods. This multi-institutional prospective observational cohort study followed hospitals enrolled in both the American College of Surgeons NSQIP and ISQIC postdischarge VTE chemoprophylaxis CQIP over a 3-year period. Patients met inclusion criteria if they were ≥18 years of age and underwent abdominopelvic surgery for malignancy, and surgery was performed by a general surgeon (or subspecialty of general surgery), urologist, or gynecologist. Patients were excluded if they underwent outpatient surgery, suffered inpatient death, or were not prescribed postdischarge chemoprophylaxis due to an appropriate clinical contraindication (eg, on full dose anticoagulation).

As per prior ISQIC investigations, the study time periods were divided into 3 implementation phases: preimplementation (year 1), implementation (year 2), and postimplementation (year 3).[17] To account for hospitals entering the CQIP at different periods, the year of participation was indexed to the year each hospital enrolled in the CQIP. Hospitals with complete data were analyzed. Hospitals were categorized as high or low performers based on process measure adherence rates. We defined high-performing hospitals as those with ≥80% adherence rate and/or >10% increase in adherence rates over the 3 phases of the study. Low-performing hospitals were defined as participating hospitals that achieved <80% adherence and/or ≤10% increase in adherence over the 3 phases of the study.

Outcomes and Statistical Analysis. The primary outcome was adherence to the postdischarge VTE chemoprophylaxis process measure. The Rao-Scott χ^2 test with hospital-clustered robust standard errors was used to calculate the change in adherence at the patient level from preimplementation to postimplementation. Unadjusted and adjusted associations between adherence and individual-level characteristics were estimated. Consistent with previous ISQIC analyses, logistic regression models were adjusted for patient-level characteristics and comorbidities, as well as procedure type.[11,17] Procedure type was grouped into 4 categories of surgeries, all performed for

malignancy: colorectal (colectomy and proctectomy), hepatopancreaticobiliary (pancreatectomy and hepatectomy), urology (any abdominopelvic urologic procedure for malignancy), and gynecologic (any abdominopelvic gynecologic procedure for malignancy). Changes in rates of adherence were calculated at the hospital level from preimplementation to postimplementation. The level of statistical significance was set at $P < 0.05$. Statistical analyses were performed in STATA MP 17.0 (StataCorp LLC, College Station, TX) and SAS 9.4 (SAS Institute, Cary, NC).

Qualitative Methods. To identify barriers and facilitators to postdischarge VTE chemoprophylaxis adherence, semistructured interviews were conducted across 6 ISQIC hospitals between December 2020 and April 2021. The goal was to understand barriers to implementation, why process measure adherence varies across hospitals, what, if any, facilitators were present, and how ISQIC can assist in improving adherence to the process measure. Interviewees and focus group members consisted of surgeon champions, surgical clinical reviewers, other stakeholder clinicians, and QI team members.

A team with expertise in gastrointestinal surgery, qualitative research methods, and health services research iteratively developed the interview guide. Content was developed using a modified version of the Consolidated Framework for Implementation Research to ensure that important domains related to patients, clinicians, and the healthcare setting were included. The interviews were performed by 2 members of the ISQIC team experienced in conducting qualitative interviews (R.P.M. and B.D.). All interviews were conducted virtually over Zoom (Zoom Video Communications, Inc, San Jose, CA), audio recorded, and transcribed verbatim. A codebook was finalized through study team consensus. Emergent themes were identified through an inductive coding method. Discrepancies were reconciled by the constant comparative approach. Thematic saturation was reached after the 6 focus groups (3 high-performing hospitals and 3 low-performing hospitals), and thus, a second round of interviews was not initiated.

Ethics

Participants provided verbal informed consent prior to each interview after receiving information about the goals of the study. They were not compensated for their participation. The Northwestern University Institutional Review Board deemed this project to be exempt.

RESULTS

A total of 2012 patients at 16 hospitals underwent abdominopelvic surgery for malignancy during the study period. Of these patients, 52.5% were female and 48.6% were aged <65 years. A total of 1178 (58.6%) of patients passed the postdischarge VTE chemoprophylaxis measure (Table 1).

At the patient level, VTE chemoprophylaxis adherence increased by ≈13% from preimplementation (51.8%) to postimplementation (64.5%; $P < 0.05$). In unadjusted analyses, race, American Society of Anesthesiology (ASA) class, and procedure type were associated with adherence to postdischarge VTE chemoprophylaxis ($P < 0.05$). After risk adjustment, factors independently associated with an increased odds of process measure adherence were urologic procedure type (odds ratio [OR], 1.76 [95% CI, 1.27–2.43]; reference = colorectal procedures), gynecologic procedures (OR, 3.90 [95% CI, 2.73–5.58]), ASA class III (OR, 3.08 [95% CI, 1.42–6.69]; reference = ASA class I/II), ASA class IV (OR, 4.88 [95% CI, 1.94–12.25]), and other or unknown race (OR, 2.09 [95% CI, 1.19–3.68]; reference = White; Table 2).

TABLE 1.

Characteristics of Patients Who Underwent Abdominopelvic Cancer Surgery at ISQIC-Enrolled Hospitals

Characteristic	Total Patients, n (%)
Age, y	
<45	120 (6.0)
45–64	857 (42.6)
65–74	568 (28.2)
75–84	345 (17.2)
>85	122 (6.1)
Sex	
Male	1057 (52.5)
Female	955 (47.5)
BMI	
<18.5	46 (2.3)
18.5–24.9	518 (25.8)
25–29.9	648 (32.2)
>30	800 (39.8)
Race	
White	1634 (81.2)
Black	214 (10.6)
Asian	68 (3.4)
Other/unknown	96 (4.8)
Ethnicity	
Hispanic/Latino	102 (5.1)
Non-Hispanic/Latino	1877 (93.3)
Unknown	33 (1.6)
Current smoker	
Yes	251 (12.5)
No	1761 (87.5)
Functional status	
Independent	1986 (98.7)
Dependent	26 (1.3)
ASA class	
I	31 (1.5)
II	707 (35.1)
III	1194 (59.3)
IV	77 (3.83)
V	3 (0.2)
Dialysis	
Yes	7 (0.3)
No	2005 (99.7)
Surgical specialty	
Colorectal	1390 (69.1)
HPB	161 (8.0)
Urology	199 (9.9)
Gynecology	262 (13.0)

BMI indicates body mass index; HPB, hepatopancreaticobiliary.

At the hospital level, 50% (n = 8) improved their adherence rate from the preimplementation phase to the postimplementation phase. Only 1 of 16 hospitals (6.3%) had ≥80% adherence rates to the postdischarge VTE process measure in the preimplementation period, but 4 hospitals (25.0%) demonstrated ≥80% adherence by the postimplementation phase. Of 12 hospitals with <80% adherence by the postimplementation phase, 4 hospitals (25%) demonstrated gains in adherence >10% between preimplementation and postimplementation periods (Table 3). Accordingly, a total of 8 hospitals (50%) were categorized as high performers (4 hospitals with ≥80% overall adherence plus 4 hospitals that demonstrated incremental adherence gains >10%). The trajectory of adherence to the process measure of each participating program is shown in Figure 1.

Qualitative Results

Three themes emerged as important barriers and facilitators to postdischarge VTE chemoprophylaxis: surgeon buy-in, multidisciplinary integration, and technical difficulties (Supplement 5, see http://links.lww.com/AOSO/A479). In the case of surgeon

TABLE 2.

Unadjusted and Adjusted Associations Between Patient Characteristics and Adherence to Postdischarge VTE Chemoprophylaxis Process Measure

	Unadjusted Analyses			Adjusted Analyses
	Process Measure Adherence			
Characteristics	Nonadherent, n = 844 (%)	Adherent, n = 1178 (%)	*P*	OR (95% CI)
Age, y			0.47	
<45	48 (5.8)	72 (6.1)		Ref
45–64	356 (42.7)	501 (42.5)		0.83 (0.55–1.25)
65–74	222 (26.6)	346 (29.4)		0.84 (0.55–1.23)
75–84	151 (18.1)	194 (16.5)		0.73 (0.46–1.15)
>85	57 (6.8)	65 (5.5)		0.67 (0.39–1.16)
Sex			0.07	
Male	424 (50.8)	531 (45.1)		Ref
Female	410 (49.2)	647 (54.9)		0.97 (0.80–1.18)
BMI			0.08	
<18.5	23 (2.8)	23 (2.0)		0.84 (0.45–1.59)
18.5–24.9	230 (27.6)	288 (24.5)		Ref
25–29.9	274 (32.9)	374 (31.8)		1.06 (0.83–1.35)
>30	307 (36.8)	493 (41.9)		1.06 (0.83–1.35)
Race			0.01	
White	686 (82.3)	948 (80.5)		Ref
Black	91 (10.9)	123 (10.4)		0.91 (0.67–1.23)
Asian	32 (3.8)	36 (3.1)		0.86 (0.51–1.44)
Other/ unknown	25 (3.0)	71 (6.0)		2.09 (1.19–3.68)
Ethnicity			0.74	
Hispanic/ Latino	40 (4.8)	62 (5.3)		0.90 (0.57–1.41)
Non-Hispanic/ Latino	782 (93.8)	1095 (93.0)		Ref
Unknown	12 (1.4)	21 (1.8)		0.80 (0.33–1.92)
Current smoker			0.42	
Yes	110 (13.2)	141 (12.0)		0.88 (0.66–1.17)
No	724 (86.8)	1037 (88.0)		Ref
Functional status			0.20	
Independent	820 (98.3)	1166 (99.0)		Ref
Dependent	14 (1.7)	12 (1.0)		0.64 (0.29–1.44)
ASA class			<0.001	
I	20 (2.4)	11 (0.9)		Ref
II	331 (39.7)	376 (31.9)		2.03 (0.93–4.39)
III	457 (54.8)	737 (62.6)		3.10 (0.93–6.69)
IV	25 (3.0)	52 (4.4)		4.89 (1.95–12.25)
V	1 (0.1)	2 (0.2)		5.33 (0.43–66.83)
Dialysis			0.11	
Yes	5 (0.6)	2 (0.2)		0.19 (0.34–1.10)
No	829 (99.4)	1176 (99.8)		Ref
Surgical specialty			<0.01	
Colorectal	649 (77.8)	741 (62.9)		Ref
HPB	73 (8.8)	88 (7.5)		0.92 (0.66–1.29)
Urology	66 (7.9)	216 (18.3)		1.76 (1.27–2.43)
Gynecology	46 (5.5)	133 (11.3)		3.90 (2.74–5.58)

BMI indicates body mass index; Ref, reference.

TABLE 3.

Preimplementation, Implementation, and Postimplementation Adherence to Postdischarge VTE Process Measure by Site

Site	Preimplementation, n, (%)	Implementation, n, (%)	Postimplementation, n, (%)
Hospital 1	71 (64.6)	116 (68.6)	155 (85.7)
Hospital 2	26 (56.5)	45 (76.3)	65 (84.4)
Hospital 3	13 (28.3)	21 (25.9)	60 (50.9)
Hospital 4	10 (47.6)	8 (29.6)	6 (17.7)
Hospital 5	3 (20.0)	13 (37.1)	2 (13.3)
Hospital 6	41 (87.2)	71 (92.2)	88 (92.6)
Hospital 7	0 (0)	1 (25.0)	0 (0)
Hospital 8	4 (12.9)	4 (11.8)	1 (3.9)
Hospital 9	0 (0)	0 (0)	1 (33.3)
Hospital 10	0 (0)	1 (5.0)	0 (0)
Hospital 11	7 (58.3)	11 (73.3)	7 (22.6)
Hospital 12	4 (28.6)	10 (35.7)	10 (20.4)
Hospital 13	4 (26.7)	3 (23.1)	1 (14.3)
Hospital 14	6 (27.7)	4 (21.1)	22 (66.7)
Hospital 15	5 (26.3)	8 (30.8)	16 (55.2)
Hospital 16	51 (76.1)	68 (87.2)	115 (90.6)

buy-in, for various reasons and concerns, surgeons were not uniformly prescribing guideline-adherent care. A recommendation to improve adherence was to publicly publish deidentified collaborative-wide reports to promote transparency and leverage natural competition. Another barrier was when all members of the team were not fully informed on the importance and duration of postdischarge VTE chemoprophylaxis. Integrating the project into other structured initiatives was reported as helpful for improving adherence. In addition, it was noted that without a notification in the electronic health record, providers may forget to prescribe postdischarge chemoprophylaxis. Automated best practice alerts that triggered prepopulated order sets were suggested to combat this barrier.

Furthermore, qualitative analyses revealed thematic differences between the high- and low-performing hospitals. High performers tended to note improved and early communication between team members, as well as discussion and reflection on the data they received from the ISQIC team. Lower performers reported multiple hurdles to project initiation because the project was seen as a lower priority due to a low incidence of cases. In addition, some low-performing hospitals reported limited resources and overcapacity to participate in additional QI projects (Fig. 2).

DISCUSSION

Despite the focus on improving VTE chemoprophylaxis for hospitalized patients, 30% to 50% of VTE complications occur after patients are discharged from the hospital.[18] Given that postdischarge VTE is a leading cause of mortality in patients who undergo abdominopelvic surgery for malignancy,[1,19] the American College of Chest Physicians and the National Comprehensive Cancer Network recommend postdischarge VTE chemoprophylaxis for a total of 28 days after major abdominal and pelvic cancer surgery.[4,20]

However, adherence to postdischarge chemoprophylaxis guidelines for this patient population remains suboptimal.[10,21,22] It has been hypothesized that the low rate of prescription of appropriate postdischarge VTE chemoprophylaxis is secondary to medication costs, patient nonadherence, and surgeon hesitancy.[23] Little is known about patient or hospital factors associated with a lack of guideline-adherent care in prescribing postdischarge VTE chemoprophylaxis in indicated patients after abdominopelvic cancer surgery. This study is the first mixed-methods evaluation of a CQIP aimed at improving postdischarge VTE chemoprophylaxis rates. We found high levels of hospital-level variation that ranged from 4.7% to 93.4% by the postimplementation phase. We identified barriers and facilitators to implementation at both high- and low-performing hospitals on qualitative analysis. The importance of early communication, reflection on hospital-specific data, and identification of obstacles was emphasized.

Most of the literature surrounding postoperative VTE chemoprophylaxis in patients with cancer centers on inpatient hospital adherence rates.[11,24,25] In a systematic review of thoracic surgery patients, only 6 of 22 studies reported data on postdischarge

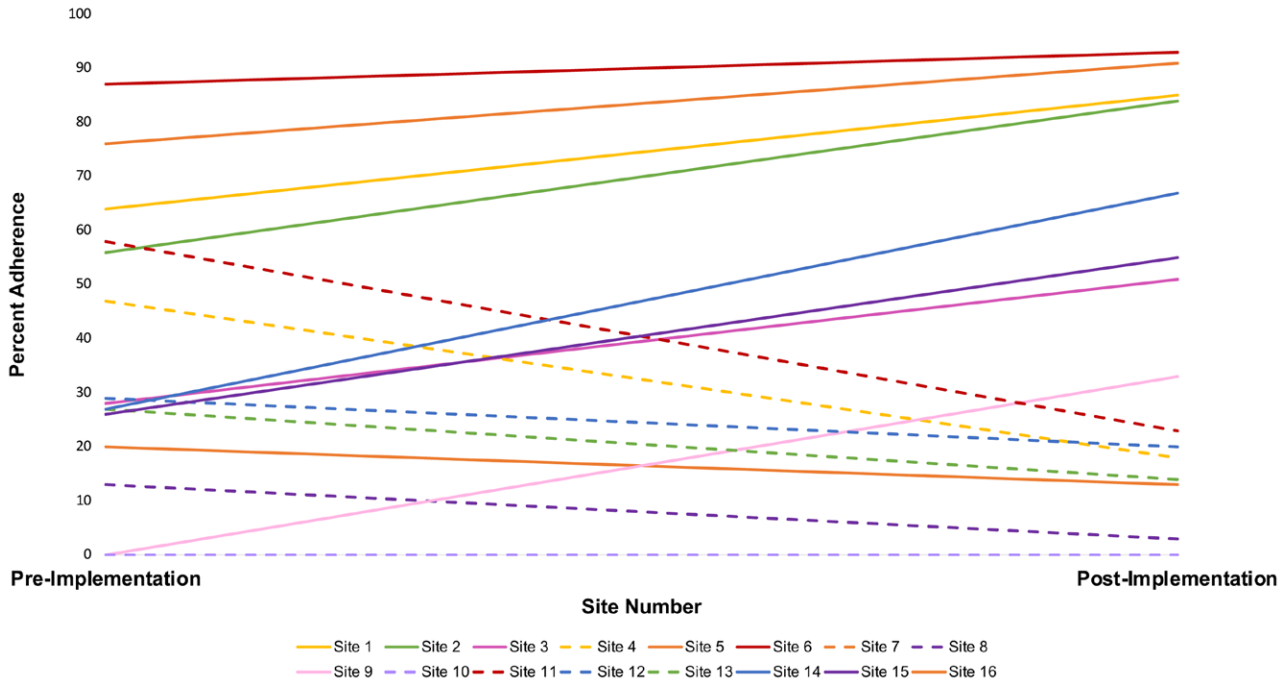

FIGURE 1. Trends in adherence to the postdischarge VTE process measure at ISQIC hospitals by site.

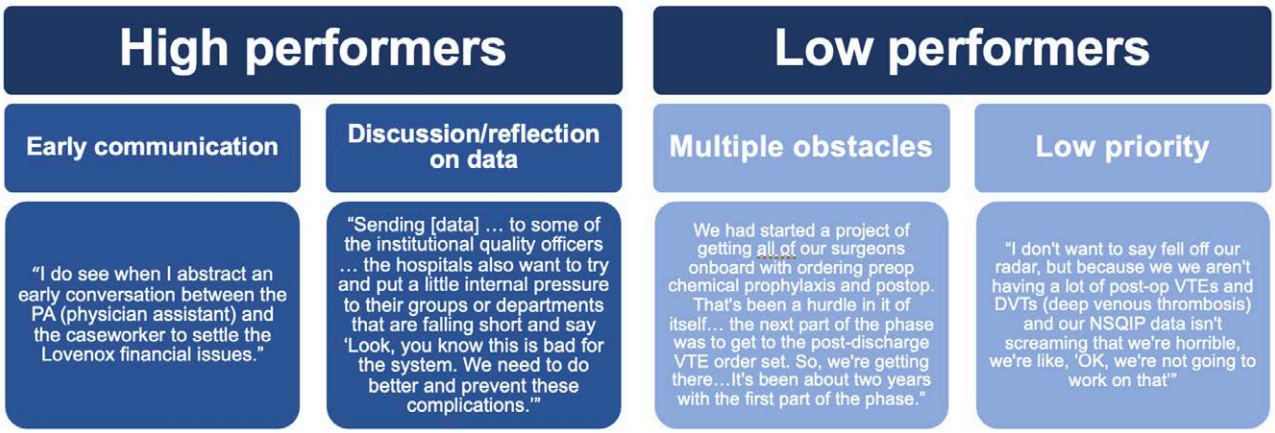

FIGURE 2. Themes and representative quotes from high- and low-performing hospitals.

quality.[26] Notably, none of these studies focused on patient or hospital factors associated with postdischarge VTE chemoprophylaxis prescribing. Given the low prescription rates of postdischarge VTE chemoprophylaxis and the high risks of morbidity and mortality, it is critical to better understand how adherence may be enhanced by identifying and targeting barriers and facilitators of guideline-recommended practice.

While hospital variation is highlighted in our results, the patient-level characteristics associated with increased postdischarge VTE adherence warrant consideration. Our finding of an association between gynecologic and urologic procedures and chemoprophylaxis may be attributable to systematic differences in surgeon background. These procedures may be more likely to be performed by specialty-trained oncologic surgeons, whereas colorectal procedures may be more likely to be performed by general surgeons or colorectal surgeons for whom oncologic procedures comprise a smaller fraction of their procedure mix. Though we do not have this level of granular data regarding physician subspecialty, it is probable that physicians who operate on cancer more often are more up to date and adherent with postdischarge chemoprophylaxis guidelines. For example, a study from Europe found that 65% of gynecologic oncologists prescribed postdischarge chemoprophylaxis to their patients for at least 4 weeks.[27] A 2019 review of research on urologic cancer surgery concluded that such studies were "overwhelmingly in favor" of the use of postdischarge chemoprophylaxis.[28]

The literature on orthopedic surgery has identified factors associated with postdischarge VTE chemoprophylaxis adherence. A randomized controlled trial of aspirin versus low-molecular-weight heparin (LMWH) concluded that in orthopedic patients, LMWH was associated with lower adherence, and this was thought to be secondary to differences in administering these medications, with LMWH primarily administered by and aspirin primarily administered orally.[29] While aspirin is not a medication currently indicated for abdominopelvic malignancy postdischarge VTE chemoprophylaxis, there have been trials in gynecologic cancer surgery evaluating the safety of direct oral anticoagulants.[30] However, these trials postdated our study; hence, future investigation is

needed to evaluate the use of oral anticoagulants in abdominopelvic cancer surgery more broadly.

Importantly, our study highlighted how a CQIP may benefit from additional features tailored to specific hospitals. A CQIP typically takes the form of an interorganizational strategy to accelerate the improvement of targeted outcomes or issues in clinical care through collaboration.[31,32] Our postdischarge VTE chemoprophylaxis CQIP went further and offered a range of intraorganizational interventions ranging from toolkits to guided implementation, all designed to assist hospitals with improving postdischarge VTE chemoprophylaxis rates. Still, our study demonstrated much heterogeneity across hospitals in achieving success and in substantive facilitators and barriers to achievement. Moreover, we found variation in trajectories of improvement, with some hospitals improving initially during the implementation phase but then regressing by the postimplementation phase. The persisting variation that we uncovered despite the multilevel, multipronged interventions levied by our CQIP underscores the continuing need for rigorous evaluation of CQIPs to better understand how they can be deployed for maximal success and sustainability. Our findings caution against the ecological fallacy of inferring average improvement at the hospital level from overall collaborative-wide improvement: collaborative improvement may be driven by a small number of outliers within the network. Heterogeneity in improvement within the collaborative highlights the idea that a "one-size-fits-all" implementation strategy may not be effective and that tailored implementation approaches may be needed based on hospital-specific barriers and facilitators.

Limitations

This study has several limitations. First, ISQIC comprised hospitals participating in NSQIP and potentially other CQIPs with the upshot that some hospitals in our CQIP may have had seasoned hospital teams that were primed to improve quality. In these hospitals, improvement in adherence rates may reflect past initiatives, resources, and "lessons learned" from previous CQIPs that have spilled over to the postdischarge VTE chemoprophylaxis CQIP. We were unable to account for past hospital CQIP experience as a confounder in our study. Given that the baseline preimplementation adherence rate in ISQIC hospitals was 55%, far exceeding what has been previously reported in the extant literature, it stands to reason that the effect of our intervention may be greater in CQIP-naive hospitals.[8–10]

Second, this is an observational cohort study, so causal inference is precluded. We cannot attribute improvement in adherence solely to the CQIP. We cannot rule out other temporal and/or external factors that could have impacted adherence. This limitation could be addressed with a future cluster randomized trial. Third, there was considerable heterogeneity in case volumes across the ISQIC hospitals included in the study. Some hospitals had a low incidence of cases, and the results should be interpreted cautiously. A related limitation is the small number of hospitals in our study, which could render our analyses underpowered. Fourth, our data permit us to address adherence, but because VTE was a rare event, we could not evaluate whether greater adherence to postdischarge chemoprophylaxis reduced rates of postdischarge VTE rate.

Fifth, prior studies have suggested an individualized approach to prescribing postdischarge VTE prophylaxis in our study population.[33] At present, there is no specific risk-based tool to select which patients with abdominopelvic cancer should be prescribed extended postdischarge VTE that has been endorsed for widespread use. However, other studies have developed risk assessment tools to help guide this decision-making for various patient populations.[34–37] Sixth, due to current guidelines and evidence, if the patient was prescribed an oral anticoagulant, they were not included in the denominator. As more studies evaluate the efficacy of oral anticoagulants in this patient population, these medications will be important to consider and include. Finally, because the focus of this study was on providers and hospitals, we limited our interviews to these stakeholders. Future work would benefit from qualitative research involving patients in order to identify and understand barriers and facilitators from their perspective.

CONCLUSIONS

This multi-institutional cohort study highlighted a significant improvement in postdischarge VTE chemoprophylaxis after the implementation of a CQIP. However, a wide range of variations of adherence remained between hospitals after implementation. Qualitative analysis demonstrated unique barriers at low-performing hospitals that could be targeted in future iterations of the CQIP to improve postdischarge chemoprophylaxis guideline-adherent care.

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