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RESEARCH REPORT

Development and implementation of a multidisciplinary patient-centered protocol to decrease inpatient length of stay and readmissions on the vascular surgery service

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Abstract: *Background:* Inpatient length of stay (LOS) has become an important outcome measure in hospital performance ratings and quality improvement (QI) initiatives. The 30-day hospital readmission rate has traditionally been used as a counter measure to balance efforts to decrease LOS. *Aim:* The aim of our QI protocol is to identify common barriers to discharge and enable opportunities for real-time interventions as well as develop strategies to decrease 30-day readmissions. *Methodology:* We developed a division-based QI protocol based on a weekly LOS "huddle". Barriers to discharge and real-time interventions were monitored. A multipronged readmission reduction protocol was designed, addressing clinical drivers of readmission. All interventions were implemented in PDSA (Plan-Do-Study-Act) cycles. Interventions aimed to improve patient communication and included a weekly "huddle" reviewing patients with an LOS that was >4 days, barriers to discharge, post-discharge phone calls, mandatory outpatient follow-up within 2 weeks for all groin incisions and ischaemic lower extremity wounds, and protocolized distribution of calling cards with emergency and routine contact information. The primary outcome measure was the inpatient LOS and the 30-day readmission rate. *Results:* A total of 1,196 patients were include in our study, 473 after implementation of our QI protocol and 723 from the pre-intervention period. The average LOS for all inpatients decreased from 7.1 days to 6.8 days (p=0.015). The 30-day readmission rate decreased from 14.1% to 8.2% (p=0.007). The majority of readmissions, 57% (N=270), occurred within the first 2 weeks after discharge. *Conclusion:* The development and implementation of a QI protocol to reduce LOS and 30-day readmission (based on the identification of discharge barriers, enhanced patient communication, and more standardized patient follow-up) has shown promising results at our institution. Further efforts to improve the above outcomes should focus on decreasing barriers to patient-provider communication during hospitalization and after discharge.

Keywords: length of stay; multidisciplinary quality improvement protocol; readmission; Vascular Quality Initiative; vascular surgery

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The Institute of Medicine has highlighted timely, efficient, and safe hospital discharge as a marker of quality of care (Institute of Medicine Committee on Quality of Health Care in America, 2001). Therefore reducing the length of stay (LOS) is a priority for patients, clinicians,

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hospital leaders, and payers. Negative outcomes have been related to prolonged LOS, including delays in receipt of essential therapies, increased adverse events, increased medical errors, and increased in-hospital mortality (Weissman *et al.*, 2007).

Hospital readmission rates are a healthcare quality metric that is increasingly being used to evaluate hospital and provider outcomes. Many coordinated efforts have been put forth to reduce LOS and readmissions, especially after the 2010 passing of the Hospital Readmission Reduction Program in the Affordable Care Act, which publicized hospital 30-day readmission rates and created financial penalties for high readmission rates (Soeken *et al.*, 1991; Ibrahim *et al.*, 2017). As a quality metric, readmission rates have been shown to increase system costs, utilization of limited resources, patient burden, and workloads for inpatient and outpatient care teams (Duwayri *et al.*, 2016).

Efforts to decrease the LOS and readmission rates have identified poor communication between patients, providers, and ancillary services as barriers (Encinosa *et al.*, 2006; Duwayri *et al.*, 2016). Specific interventions such as comprehensive discharge planning, provider-initiated phone follow-up, and early physician follow-up have been found to be effective in lowering LOS and hospital readmission rates (Kent *et al.*, 2011; Naylor *et al.*, 2011).

Vascular surgery has frequently been reported as having one of the highest readmission rates of all surgical specialties, with rates up to 23.9% for 30-day readmissions (Soeken *et al.*, 1991). The increased readmission rates reported in vascular surgery have largely been attributed to overall patient illness and comorbidities; specifically, for patients aged >75 years and those with a history of diabetes (Jackson *et al.*, 2011; Martin *et al.*, 2011).

We hypothesize that with regular patient screening, identification of discharge barriers, effective patient provider communication and follow-up through a multidisciplinary quality improvement (QI) initiative, the LOS as well as the unplanned 30-day readmission rates for the vascular surgery division will decrease.

Methodology

Overall QI approach

The Model for Improvement, developed by the Institute for Healthcare Improvement (Moen and Norman, 2010), was used as a general guide for the conception and execution of this QI initiative. This model centers around the sequential deployment of iterative "Plan-Do-Study-Act" (PDSA) cycles that enable implementation, testing, and adjustment of each alteration to pre-initiative processes, as developed and disseminated by the Associates in Process Improvement and W. Edward Deming (Giles *et al.*, 2011; Jackson *et al.*, 2011). The entire QI team uses each PDSA cycle to test the outcome of implemented changes and learn from roadblocks in the execution of changes designed *a priori*.

Design and implementation of an intervention

In our attempt to optimize timely care delivery and expedite discharges, we formulated a team of attending providers, including the quality director, the lead research resident, the inpatient advanced practice providers (APPs), as well as our case managers and nurse directors. The QI team meets on a weekly basis and patients with an LOS of >4 days are reviewed. Barriers related to discharge are identified and categorized. Subsequently, individual stakeholders including consulting services, imaging studies, laboratory or pathology results were expedited. The review results are then shared on a weekly email with all the members of the division (Figure 1).

Figure 1. Workflow of the Plan-Do-Study-Act (PDSA) cycles followed according to the herein discussed weekly quality improvement (QI) protocol. Our multidisciplinary protocol starts with a weekly QI "huddle" identifying patients with a prolonged length of stay (LOS) that is >4 days. Subsequently, all faculty / trainees and staff are notified through a divisional email leading to an organized intervention communicating with the ancillary services and expediting discharge.

An internal review was conducted of a random sample of recently readmitted patients, which determined that an outsized proportion of 30-day readmissions occurred within 2 weeks and that a significant portion of these were unplanned readmissions. Baseline performance on the 30-day readmission primary outcome measure was 14.1% in the 6 months prior to the intervention, across 723 discharges. Over half of these (57%) occurred in the first 14 days after discharge and 39% occurred in the first week after discharge. Vascular surgery patients are known to have a higher proportion of comorbidities such as diabetes, dialysis dependence, and higher American Society of Anesthesiology risk classifications, compared to patients of other surgical specialties (Deming, 2018). The complex and multidisciplinary medical care required for the

Table 1. Study population demographics of all patients included in the post-intervention period. The average age of the study population was 68.6 ± 12 years.

Parameters	Subparameters	Number of patients and percentage of the study population N=473 (100%)	Average age (mean ± standard deviation; in years)
gender	male	221 (46.7%)	68.1 ± 11.2
	female	252 (53.3%)	69.58 ± 13
race	white	407 (86%)	--
	black / African American	28 (5.9%)	--
	Asian	7 (1.5%)	--
	other / not specified	31 (6.6%)	--
payer	Medicare	236 (49.9%)	--
	MassHealth	22 (4.7%)	--
	private payer	215 (45.5%)	--

effective management of these comorbidities can make safe discharge planning and transitions of care difficult for providers, both of which have been identified as potential drivers of early unplanned readmission. The following problem statement was constructed: *'Institutional vascular surgery patients have demonstrated increased readmission rates compared to local and national peer groups, with a significant number of readmissions occurring within 2 weeks of discharge.'*

Patient population and institutional context

All surgical patients hospitalized in the vascular surgery service within our institution from April 2024 to December 2024 were included in this analysis. Patients who underwent both elective and emergent procedures were included. Patients who were admitted for medical management and did not undergo surgical interventions were excluded. Patients with primary admission to an outside facility under an institutional vascular surgeon's care were excluded.

Outcome measures and aim statement

The primary outcome measure was the average LOS and the percentage of patients readmitted within 30 days of discharge from their index admission. In the 6 months prior to the start of the intervention the vascular surgery 30-day readmission rate was 14.1% (N=102) across 723 discharges. The majority of unplanned readmissions occurred within the first two weeks after discharge. The institutional QI team constructed the following aim statement: *'To reduce postoperative 30-day readmission rates for all vascular surgical procedures at MGH, from April 2024 to December 2024.'*

Development of driver diagram and specific interventions

Our institutional QI team performed a review of departmental procedures, policies, and protocols regarding discharge and follow-up after discharge from an inpatient admission. This review identified opportunities for improvement in terms of the standardization of the discharge procedures, as well as in patient-provider communication. The QI team proposed process changes in order to improve both patient-facing and internal communication with a focus on standardization and knowledge sharing. Initial interventions were mapped to a driver diagram encapsulating the intended causal pathway from possible process change to effect on the primary outcome measure targeted in our aim statement. Interventions were launched in monthly PDSA cycles based on consensus review from the QI team members. All patients known to the division were assessed for telemedicine-readiness as part of institutional protocol for the COVID-19 pandemic.

The initial interventions consisted of telephone calls from an APP within 1 week of discharge, the distribution of calling cards that contained institutional contact phone numbers on a refrigerator magnet, and a division-wide requirement for a follow-up appointment within two weeks of discharge, with in-person visits required for all groin incisions and ischaemic lower extremity wounds. Through serial PDSA cycles, these interventions were modified to improve patient experience and provider workflow.

For example, the initial intervention for outgoing calls was rolled out with calls on day 1 and day 5 after discharge. During these encounters, an APP would confirm medications, post-op instructions, perform a focused review of systems, and address patient questions. The QI APP provided interim management of any issues elicited and directed the patient to clinic or emergency care if needed. Through serial PDSA cycles we identified that the outgoing calls added significant work burden to the inpatient team and lowered the frequency of successful intervention. The timeframe for outgoing phone calls was relaxed to within 2 weeks and funding for the APP extra work time was implemented. Performance improved from less than 5% of

patients contacted with initial call plan to 14% of patients contacted with revised plan.

Our institutional readmission rate was highest within 14 days of discharge, thus discharge protocols were standardized to include a requirement for all follow-ups to occur within 2 weeks of discharge. Through PDSA review we identified that this placed an excessive burden on the clinical staff and thus, the discharge protocols were revised to only require a 2-week in-person follow-up for patients with groin incisions or ischaemic lower extremity wounds. Through monthly PDSA cycle evaluations, we were able to modify process measures during the study and to improve the effectiveness of these interventions.

Measures and statistical analysis

The primary outcome measures for this study were the institutional specialty-specific inpatient LOS and 30-day readmission rate. Secondary outcome measures included 7-day and 14-day readmission rates. Process measures included the proportion of patients receiving a provider-initiated phone call and scheduling post-discharge follow-up within 2 weeks. Chi-square analyses or independent *t*-tests (for categorical or continuous variables, respectively) were performed in R version 4.2.2.

Results

A total of 1,196 patients were included; of these, 473 met the inclusion and exclusion criteria during the intervention period and were compared to 723 patients admitted prior to the intervention. The average age of the population was 68.6 years old. Of the 473 patients, 46.7% were males and 53.3% were females. The average age of the females was slightly older than males at 69.58 years *vs.* 68.1 years. Most of the patients (86%) identified their race as white, while 5.9% identified as black or African American, 1.5% identified as Asian, and 6.6% identified as other or did not specify their race. Most of this population were on Medicare (49.9%) or MassHealth (4.7%). Private payers accounted for the remaining 45.5% (Table 1).

The average LOS of all patients admitted to the vascular surgery service 6 months prior to the intervention was 7.1 days. After the implementation of the PDSA cycles (Figure 1) in the form of a weekly QI "huddle", weekly email communication within the provider team and subsequent address of the involved barrier (consulting service, delay in imaging, procedure, operating room waitlist, surgical complication, *etc.*) there was a significant decrease in the inpatient LOS. Our post-protocol LOS was 6.8 days (Figure 2). This decrease in our average LOS was statistically significant (p=0.015).

In the 7 months after the intervention all patients discharged from the vascular surgery service at our institution were involved in serial PDSA cycles. Process measures included the percentage of surgical booking within 2 weeks of discharge and the percentage of discharged patients receiving a check-in phone call before their follow-up appointment. The success rate for scheduling a follow-up within 2 weeks of discharge was 35% (N=148). The low rate of successful implementation was partially attributed to an unanticipated institutional migration to electronic surgical booking communication during the PDSA cycles. The success rate for the implementation of APP-directed phone calls was also low, with only 18.4% (N=87) of the discharged patients receiving a follow-up call within 2 weeks of discharge. The low adherence rate was related to barriers associated with the financial compensation of the APPs performing the outgoing phone calls, which created additional work that was initially uncompensated. This delay in funding resulted in a rapid decline in phone call performance, which recovered once funding became available. The distribution of calling cards was implemented through a nursing-driven protocol ensuring that each patient would receive a magnetic calling card with their discharge paperwork. This protocol was developed with the nursing supervisor and with nursing feedback through PDSA cycles to achieve a high level of user buy-in. It is difficult to determine the success rate of this intervention, as calling cards were not tracked. However, nursing staff reported high usage during PDSA reviews.

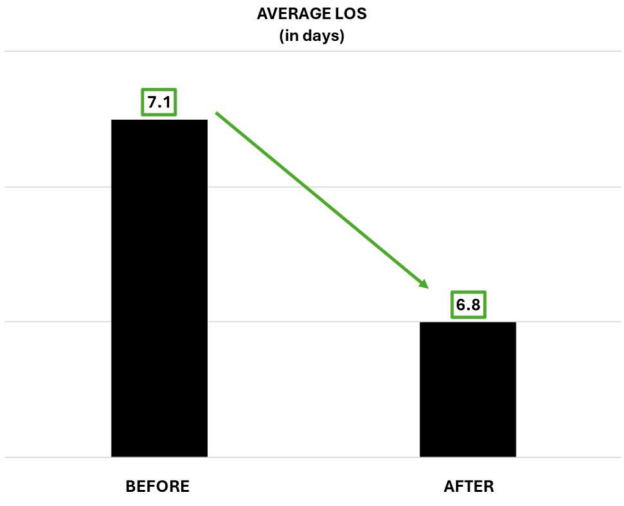

Figure 2. Average inpatient length of stay (LOS) before and after the adoption of the multidisciplinary quality improvement protocol (6 months before compared to 6 months after; p=0.015).

In the 6 months prior to intervention, the vascular surgery 30-day readmission rate was 14.1% (N=102) across 723 discharges. In the 6 months since the initiation of this multimodal QI intervention the division specific 30-day readmission rate has fallen to 8.2%

(N=39) across 473 discharges (Figure 3). The post-intervention readmission rate was significantly lower than the baseline readmission rate prior to the intervention (p=0.007). The 14-day overall readmission rate was 4.7% (N=22) and the 7-day overall readmission rate was 1.6% (N=8). These were both significantly lower compared to the 14-day and 7-day readmission rates from the pre-intervention period: 8.3% (N=60, p=0.02) and 5.5% (N=39, p=0.001), respectively. Of the 35 readmissions that occurred after the intervention, 7 (20%) occurred by day 7, and a further 20 (57%) occurred by day 14 (Figure 4). For patients who were found to be readmitted before their initial postoperative follow-up, all admissions were related to wound infection.

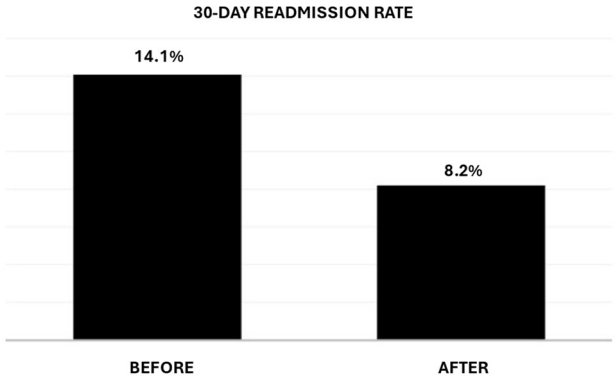

Figure 3. Comparison of the pre-intervention (before) and post-intervention (after) 30-day readmission rates after the index admission (p=0.007).

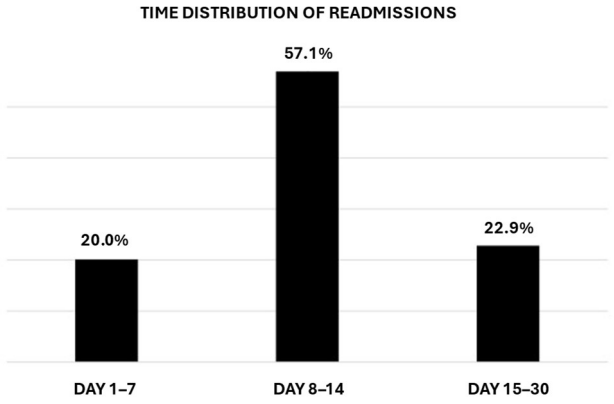

Figure 4. Distribution of readmissions occurring within the first 7 days, between day 8 and day 14, and between day 15 and day 30 after discharge.

Discussion

Hospital readmission rates are considered an important metric for evaluating postoperative care and surgeons have an interest in preventing avoidable readmissions. This study evaluated a multi-modal quality initiative aimed at reducing readmission rates. Interventions were implemented through monthly PDSA cycles and focused on improving patient communication and standardization. Specific interventions included an outgoing provider-initiated phone follow-up, mandatory follow-up within 2 weeks, providing calling cards with emergency and routine contact numbers for all patients, and standardization in the postoperative care instructions.

After implementation of a multi-modal QI program for readmission reduction, the post-intervention readmission rate was reduced from 14.1% to 8.2%, which is consistent with the nationally reported readmission data for vascular surgery (Moen and Norman, 2010; Glebova *et al.*, 2016; Papadopoulos *et al.*, 2019). Although on par with previously reported readmission rates, the overall readmission rate for vascular surgery remains higher than those of other surgical specialties (Moen and Norman, 2010). This has been attributed to a high rate of comorbidities, and surgical wound infections have been identified as a key risk factor for readmission in vascular surgery (Han *et al.*, 2015; Deming, 2018). Vogel *et al.* (2018) have reported that a below knee amputation during the index admission was a risk factor for readmission, and this risk has been attributed primarily to undiagnosed or untreated wound infections (Feldman *et al.*, 2022). In our study, of the patients who were readmitted before their follow-up call, all were readmitted due to a wound infection. This finding supports prior reports that have identified surgical wounds and wound infections as a risk factor for readmission, and specifically for vascular surgery admissions (Moen and Norman, 2010).

Our institutional QI team developed a plan to reduce readmission rates through interventions aimed at improving the patient-provider communication after discharge. The program bundled of multiple process changes, including post-discharge phone calls, calling cards with contact information, and standardized 2-week clinic follow-up. These interventions were implemented through monthly PDSA cycles that allowed for the modification of intervention protocols based on user feedback.

Previous authors have reported that QI interventions including post-discharge telephone calls, or calls bundled with other interventions, may impact readmission rates (Hornick *et al.*, 2016; Vogel *et al.*, 2018). Other authors have reported a reduction in readmission rates with phone calls from a registered nurse or medical assistant, after the utilization of standardized surveys (Vogel *et al.*, 2018). The interventions in our study differed in that phone calls were made by APPs with specific experience in postoperative care, which enabled the provider to perform real-time interventions and not only serve as a referral or screening program. During calls, APPs were instructed to perform a brief focused review of symptoms, confirm medication adherence and wound care instructions, and answer patient questions and concerns. Frequent interventions

performed by the providers included reviewing postoperative care instructions. APPs reported that only 10% of their effort was coordinating care such as helping schedule follow-up appointments. The implementation of phone calls from an APP may not be suitable for all practice environments. The results of our study support a previously reported observation that bundled interventions including early provider-initiated phone follow-ups can impact readmission rates (Vogel *et al.*, 2018).

In our data, there was a higher proportion of readmission within the first 14 days (77.1%) after discharge compared to days 15 to 30 after discharge (22.9%). It has been proposed by previous authors that there may be different drivers for early readmissions (i.e., for 14-day readmissions as compared to 30-day readmissions). This study was not designed in order to identify risk factors for readmission; however, in our study, 4 of the 64 patients successfully contacted by phone had already been admitted prior to their follow-up call, thereby indicating readmission within 14 days of discharge. Individual chart review of the readmitted patients revealed that all were related to wound infection. Thus, wound infection may specifically increase the risk of early readmission within 14 days of discharge, although our study was not powered for this comparison.

The findings of this study should be interpreted in light of several limitations. As is expected in the non-controlled setting of a PDSA-style QI initiative, there were likely other factors impacting performance on the process, balance, and certainly outcome measures that cannot be ascertained. We were unable to identify unique patient identifiers from our institutional readmission data, which has limited our ability to decipher which patients had received QI interventions and thus, if one of the interventions weighed more significantly in reducing readmission. The baseline pre-intervention process and the appropriateness of process-specific interventions may be particular to our institution; therefore, generalizability to other institutions may be limited. However, given the physiologic justification for multiple process changes undertaken in this initiative, there may be considerable opportunities for applicability of these interventions on a wider scale.

The consensus-driven development and implementation of a QI protocol in order to reduce inpatient LOS and 30-day readmission, based on increased patient communication and more standardized patient follow-up, showed promising results at our institution, with over 25% improvement in the primary outcome measure. Further efforts to improve the above metrics should focus on decreasing barriers to patient-provider and provider-provider communication during hospitalization and after discharge.

Conclusion

A weekly multidisciplinary QI protocol can identify barriers to patient discharge and reduce inpatient LOS on the vascular surgery service. Enhanced patient-provider as well as provider-provider communication are key elements allowing uneventful and timely patient discharge. Postoperative readmission rates, when used as a counter-measure, do not seem to be affected by this intervention.

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Conflicts of interest statement

None to declare.

Data availability statement

The data that support the findings of this study are available from the corresponding author, upon reasonable request.

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