Focused Resident Education and Engagement in Quality Improvement Enhances Documentation, Shortens Hospital Length of Stay, and Creates a Culture of Continuous Improvement

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PURPOSE: System-based practice with an emphasis on quality improvement (QI) is a recent initiative for the American College of Surgeons and a core-competency for surgical trainees. Few surgical training programs have a curriculum for hospital-based QI.

METHODS: Our vascular surgery service implemented several QI initiatives focused on decreasing length of stay (LOS) by targeting resident education and engagement. Residents were educated on terminology and processes impacting hospital and CMS QI metrics such as Medicare geometric mean LOS (CMS GMLOS) and diagnostic-related groups (DRG) with complication or comorbidity (CC/MCC) coding. LOS initiatives focused on identifying, tracking and removing avoidable perioperative delays, and improving accuracy of clinical documentation. Residents were given specific roles in QI initiatives and the impact on LOS was quantified. Patients' CMS GMLOS were compared to actual LOS during daily rounds, with confirmation that resident progress notes contained thorough and accurate documentation of diagnoses, comorbidities, and complications. Ten minutes during weekly preoperative conferences were dedicated to ongoing QI, with LOS metrics for the inpatient census presented by trainees and reviewed by attendings. Feedback was given addressing barriers to avoidable delays and impact on LOS. Data for July 2016-June 2017 (FY17) was compared to preimplementation baseline data (FY16) for vascular discharges overall. Accurate documentation of acuity was evaluated with in-depth review of notes and overall case mix index.

RESULTS: Within the first year of implementation, overall vascular admissions demonstrated a 21% reduction in LOS, closing the gap between observed LOS and expected CMS GMLOS, from 2.1 days to 0.5 days on average. Documentation improved, with a shift in 24% of DRGs to accurately reflect CC/MCC. Overall case mix index increased by 10%, from 3.07 to 3.37.

CONCLUSIONS: A culture of continuous quality improvement can be created with the establishment of a QI infrastructure that educates and involves trainees as stakeholders. Assigning discrete roles to increase resident accountability supports both formal and informal resident education that can substantially impact hospital benchmarking metrics. (J Surg Ed 76:771−778. © 2018 Association of Program Directors in Surgery. Published by Elsevier Inc. All rights reserved.)

KEY WORDS: Vascular surgery education, quality improvement in health care system, resident education

COMPETENCIES: Systems-Based Practice, Practice-Based Learning and Improvement

INTRODUCTION

System-based practice with an emphasis on quality improvement (QI) has become a recent focus for the American College of Surgeons (ACS) and is a core-

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competency for surgical trainees. However, program compliance and trainee demonstration of competency in the domain of system-based practice varies widely in the interpretation of individual components.[1] Despite the expectation that residents undertake QI projects during training, few programs have a formal curriculum to address QI initiatives within their own hospitals.

In an effort to improve benchmarking quality metrics, some medical systems have created targeted pathways for patient care to reduce hospital costs and length of stay, and increased the standardization of coding to decrease missed billing opportunities.[2,3] Aiello et al. describe a physician-initiated program to increase knowledge of coding and billing which demonstrated improvements in case mix index (CMI) and contribution margin, but such programs neglect trainees as relevant stakeholders.[4] In fact, only a few hospital-based QI programs have an emphasis on resident education.[5]

This study describes our hospital-based quality initiative, or Care Delivery Redesign (CDR), which incorporated trainees into critical components of patient quality metric reporting within our vascular surgery division, while ensuring faculty and staff hold shared accountability for outcomes. The aim of this study was to use open dialogue among faculty, trainees, and hospital staff to create improvements in documentation and reduce hospital length of stay. We educated both trainees and staff through a program embedded into daily operations with the intention of integrating all team members into the collection and interpretation of patient care data.

METHODS

The vascular division at our medical center consists of 8 full time faculty, 3 rotating vascular fellows, and 2 to 3 rotating junior residents from all surgical subspecialties, as well as 1 full time inpatient nurse practitioner (NP). This study was approved by the USC Health Sciences Institutional Review Board.

Program Design

A multidisciplinary CDR committee was created by our academic medical center in April 2016 in response to high spending and performance gaps. Benchmarks were set by the Centers for Medicare and Medicaid Services (CMS) and peer organizations that were identified by hospital administration. Full organizational details are described elsewhere,[6] but briefly, CDR committee members included a physician champion, a nursing champion, and a case manager for each division, who met on a biweekly basis with the hospital's Value Improvement Office (VIO). A variety of quality improvement initiatives were supported by the hospital, but each was designed and implemented at the discretion of the individual division. All involved divisions received initial best documentation guidelines from the hospital and tracking of patients with specific Diagnostic Related Groups (DRG), which accounted for about 30% to 40% of their service volume. Monthly reports were generated comparing the length of stay (LOS) after discharge to ideal benchmarking LOS for those targeted DRGs.

Additionally, the vascular division provided educational material for fellows and residents at 3 different levels. For orientation, incoming trainees were asked to download service content on a mobile application before the start of their rotation. Within their first week, each met individually with the service nurse practitioner and a Clinical Documentation Improvement (CDI) officer regarding service-specific best documentation practices. CDI officers are employed by our hospital to assist physicians in providing appropriate documentation of patient acuity, traditionally through documentation queries to clarify severity of clinical presentations. During weekly conferences, the vascular surgery fellow presented the details of the current census for discussion. On a daily basis, the interns and residents reviewed the LOS for each patient with the NP or faculty members, in order to identify patients at risk for delays in care.

Orientation: Mobile Application and Service Expectations

Service content was made available using a mobile and online platform, AgileMD (AgileMD Inc, San Francisco). Full content of the app, as well as a breakdown of utilization data, has been previously described.[7] Briefly, app content included several categories of pages, including service expectations and organization, patient care and order-sets, documentation, and educational materials (Fig. 1). The app could be downloaded, used off-line, and updated content was refreshed when an internet connection became available. An invitation was sent to all rotating trainees before the start of their rotation.

Onsite Orientation

During the first week of a rotation, residents received a service orientation by our NP and the Clinical Documentation Improvement officer. Residents were educated on terminology and processes impacting hospital and CMS QI metrics, such as Medicare geometric mean LOS (CMS GMLOS), and DRG with or without complication or comorbidity (CC/MCC) coding.

Weekly Census Tracker and Team Member Roles

A review of the inpatient census, as well as a list of patients discharged during the week was generated by

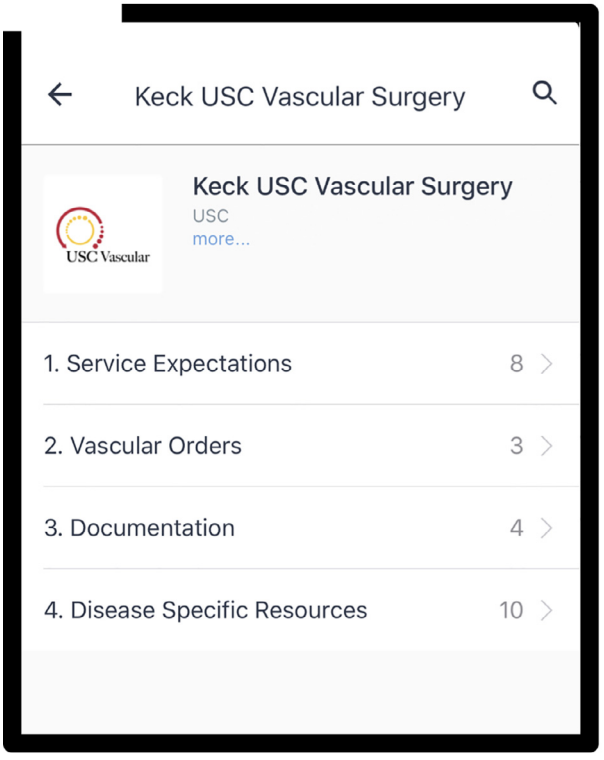


FIGURE 1. Content organization of mobile app. Main navigation screen dividing vascular mobile app into service expectations and organization, patient care and order-sets, documentation, and educational materials.

the VIO, containing assigned DRG, associated CMS GMLOS, and current LOS (Fig. 2). The current LOS compared to the working CMS GMLOS was presented as an observed to expected ratio (O/E), with color coding for O/E >1.0. The service-wide averages for each previous week were additionally reported as an O/E ratio. The accuracy of the tracker was confirmed by the NP and the documentation office on a regular basis.

It was the responsibility of the service fellow to present the inpatient census with QI tracking metrics during each weekly conference, during which delays in care were discussed between the fellow, the residents, the responsible attending, and the division chief. In addition to aggregated outcomes for the vascular division that were presented on a weekly basis, patients with LOS greater than GMLOS were highlighted for discussion. The service fellow presented the patient's course, with attention to delays in care and how each had been addressed by the team and the designated attending. Residents and interns publicly confirmed completeness of admission documentation and daily progress notes. Collectively, the division identified areas for improvement, and the division chief took individual responsibility for addressing administrative obstacles to timely patient care based upon specific patient examples. Ongoing feedback was given addressing barriers to avoidable delays and impact on LOS.

Daily Reinforcement

In addition to formal weekly review, residents were often asked to present the current LOS for patients on daily rounds. The banner of the electronic health record was updated to include current LOS and CMS GMLOS based upon the DRG currently assigned. If the assigned DRG was inaccurate, residents worked with the NP and CDI officer to ensure the accuracy of clinical documentation. Potentially avoidable delays in care were highlighted during attending rounds, and entered into a web-based tracking form by the NP. Escalation pathways were available to address the avoidable delays in real-time. Full details of our care escalation are described elsewhere.[6]

Impact on Training

Qualitative evaluation of the weekly tracker, the mobile application, and the overall program design were collected from trainees through Google forms and through semistructured interviews. Rotating residents evaluated there experience compared to other surgical services. Vascular fellows were asked to identify the impact of CDI on their future practice.

Primary and Secondary Outcomes

The primary outcome in this study pertains to overall LOS, and the calculated gap between LOS and GMLOS based upon DRG. Secondary outcomes include measurement of the effects of documentation, DRG assignment with or without CC/MCC additions, and CMI.

Data for July 2016 to June 2017 (FY17) were compared to preimplementation baseline data (FY16) for the hospital QI metrics of LOS, CMI, and DRG assignment. Analyses were performed using SPSS v.24.0; statistical significance was set at p 0.05.

RESULTS

Patient Length of Stay

Within the first year of implementation, overall vascular admissions demonstrated a 23% reduction in LOS (Table 1). The average length of stay for all vascular surgery inpatient admissions was 5.4 ± 7.8 days for FY17, down from 6.9 ± 7.8 days in FY16 (p 0.003). The average CMS GMLOS remained consistent at 4.88 ± 2.41 from 4.78 ± 2.62 days, respectively (p 0.387). This resulted in a dramatic decrease in the gap between our medical center and CMS benchmarks, with an average

Weekly Patient LOS Report - Vascular Service Line
Jun 15 - 21, 2017

06/21/2017

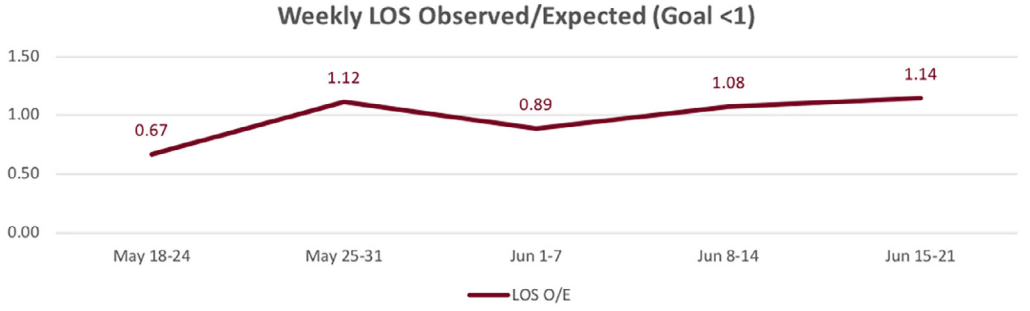
In-house

Patient Name	MRN	Attending Physician	Admit Date	Discharge Date	LOS	Working CMS GMLOS	MS-DRG	MS-DRG Description	ICU LOS	Current Unit	Working LOS O/E	Comments
					2	2.6	301	PERIPHERAL VASCULAR DISORDERS W/O CC/MCC	0	5N	0.77	
					9	6.6	268	AORTIC AND HEART ASSIST PROCEDURES EXCEPT PULSATION BALLOON W MCC	8	7W	1.36	Max GMLOS for this DRG group
					6	4.4	241	AMPUTATION FOR CIRC SYS DISORDERS EXC UPPER LIMB & TOE W/O CC/MCC	0	5N	1.36	
					3	2.7	605	TRAUMA TO THE SKIN, SUBCUT TISS & BREAST W/O MCC	0	OR	1.11	
					3	4.7	221	CARDIAC VALVE & OTH MAJ CARDIOTHORACIC PROC W/O CARD CATH W/O CC/MCC	3	7W	0.64	
					2	3.2	903	WOUND DEBRIDEMENTS FOR INJURIES W/O CC/MCC	0	5N	0.63	
					1	1.9	269	AORTIC AND HEART ASSIST PROCEDURES EXCEPT PULSATION BALLOON W/O MCC	0	5N	0.53	

Discharged

Patient Name	MRN	Attending Physician	Admit Date	Discharge Date	LOS	Working CMS GMLOS	MS-DRG	Working DRG	ICU LOS	DC Unit	Working LOS O/E	Comments
			6/16/2017	6/20/2017	4	4.3	253	OTHER VASCULAR PROCEDURES W CC	3	5N	0.93	
			6/15/2017	6/17/2017	2	2.6	301	PERIPHERAL VASCULAR DISORDERS W/O CC/MCC	0	5N	0.77	
			6/15/2017	6/16/2017	1	2.4	254	OTHER VASCULAR PROCEDURES W/O CC/MCC	0	5N	0.42	

AVG D/C LOS:	5.00
AVG GMLOS:	4.38
Weekly Working O/E:	1.14



Length of stay (LOS), Medicare geometric mean length of stay (CMS GMLOS), observed: expected ratio (LOS O/E).

FIGURE 2. Sample weekly tracker. List of length of stay (LOS) for current hospital census and recently discharged patients, with associated Diagnostic Related Groupings (DRG) and medicare geometric mean LOS (GMLOS). LOS compared to the working CMS GMLOS presented as an observed to expected ratio (LOS O/E).

TABLE 1. Length of Stay (LOS) and Case Mix Index (CMI) by Fiscal Year (FY)

	FY16			FY17					
	n	***Ave days***	±	***n***	***Ave days***	±	**Diff**	**% Change**	**p value**
LOS	405	6.9	7.8	358	5.4	5.7	−1.5	−21.4%	**0.003**
GMLOS		4.8	2.6		4.9	2.4	0.1	2.4%	0.387
Gap (LOS-GMLOS)		2.1	6.8		0.5	5.0	−1.6	−74.6%	<**0.001**
LOS/GMLOS (O:E)		1.5	1.4		1.1	0.9	−0.4	−25.2%	<**0.001**
CMI		3.07	1.85		3.37	1.86	0.30	9.6%	**0.011**

CMI, case mix index; LOS, length of stay; GMLOS, medicare geometric mean length of stay; O:E, observed:expected ratio.

gap of 0.55 ± 4.98 days in FY17, compared to 2.13 ± 6.84 days in FY16 ($p < 0.001$). There was an average observed to expected ratio (O/E) LOS/GMLOS decrease from 1.5 ± 1.4 in FY16 to 1.1 ± 0.9 in FY17 ($p < 0.001$).

Documentation and Coding

Increased documentation efforts and communication with hospital coders through the clinical documentation improvement office demonstrated improved acuity in documentation. DRGs demonstrated a 24% reduction in those DRGs coded without CC/MCC, from 30% to 23% of the total volume (Table 2). This translated into a 12% increase in DRG volume coded either with CC (32% to 36%) or with MCC (37%-41%). The CMI increased by 10%, from 3.07 in FY16 to 3.37 in FY17 (p 0.011).

Trainee Reception

Overall, trainees expressed appreciation for the dedicated education on patient quality metrics and connecting administrative data to individual patients. All trainees believed the program was a novel experience and applicable to their future careers. Residents specifically valued the visible connection between daily documentation, hospital coding, and factors affecting reimbursement, as well as an understanding of how avoidable delays could be individually targeted and prevented. Fellows reported a greater understanding of administrative systems, and reported the experience to be an asset discussed during their job interviews.

DISCUSSION

The American College of Surgeons (ACS) describes an ideal surgical community which embraces the quality and patient safety movement by integrating teams that strive to improve patient care through active assessment and evaluation of performance, and the development of best practices based upon that evidence.[8] The recently published book *Optimal Resources for Surgical Quality and Safety* calls for a multi-disciplinary approach and serves as a manual for the development of local infrastructure and surgeon commitment in all phases of patient care.[9] A goal of this comprehensive manual is to provide all team members with the resources necessary to improve patient outcomes. Yet, there is little mention of residents and fellows who are responsible for the delivery and documentation of a significant amount of patient care within most academic medical centers. Furthermore, it is a national requirement that residents participate in clinical patient safety activities during their training.[10]

Focusing on quality improvement, 2 Accreditation Council for Graduate Medical Education core competencies charge training programs to produce competent physicians who engage in lifelong learning and reflect on their role in delivering high-quality, value-based healthcare. Both practice-based learning and improvement, and systems-based practice, have been particularly difficult to define in practice and measure objectively.[11-13] Well-designed QI and patient safety initiatives have the

TABLE 2. Volume of DRG Coding

	FY16		FY17		
		n		***n***	**% Change from FY16**
W MCC	36.5%	(148)	40.8%	(146)	11.6%
W CC	31.9%	(129)	35.8%	(128)	12.3%
W/O CC/MCC	29.9%	(121)	22.6%	(81)	−24.3%
Stand-Alone	1.7%	(7)	0.8%	(3)	−51.5%
Total Volume	100%	(405)	100%	(358)	

WCC, with complication or comorbidity; WMCC, with major complication or comorbidity; W/O CC/MCC, without complication or comorbidity.

potential to address components of both system-based practice and practice-based learning and improvement, as trainees can participate and respond to the needs of their healthcare system within a larger context, while actively adapting their own personal delivery of patient care. The need for formal resident education in QI and system-based practice has been previously shown, with only 28% of program directors in surgery reporting significant quality tracking by their residents.[14]

Few standardized curricula exist for surgical residents, with a recent systematic review of post-graduate QI programs finding only six published programs in surgical residencies.[5] The majority of published QI programs for residents consist of formal didactic teaching focused on specific QI techniques, such as Root-Cause Analysis and Plan-Do-Study-Act cycles, with curricula that emphasizes declarative knowledge over immediately applicable procedural or conceptual skills. In an attempt to make QI applicable, relevant, and specific, the ACS has recently created a Quality In-Training Initiative (QITI) to provide initial steps in the development of a scalable curriculum for surgical residents.[15] This national curriculum utilizes the National Surgical Quality Improvement Program (NSQIP) database in a curriculum with didactic components, review of individual institutional practice, and breakout sessions to create best-practice guidelines. This formal curriculum has made measurable strides in patient safety through reduced infection rates. Adoption of this program may meet national requirements for graduate medical education, but it does so over the course of 2 years with projects targeting a narrow set of surgical complications, and is only available to programs with hospitals that participate in NSQIP. The benefits of such a program include standardization and the ability to expand nationally, but the narrow scope of intervention and lack of integration into the local medical system and involvement of other hospital stakeholders, reducing generalizability.

Kelz and Sellers emphasize that a gap in knowledge and implementation for QI projects exists for both faculty and residents between these different care providers.[16] A program or curriculum that uses relevant, real-world data to enlighten and educate all members of the healthcare team holds potential for meaningful change and may initiate a shift in organizational culture toward a mindset of continuous improvement. Although QI education has been described for multidisciplinary teams, education of residents, and faculty are rarely integrated. Achieving either of these competencies requires resident engagement, thoughtful and meaningful interaction with healthcare systems, and genuine knowledge and skill development that transcends training. Inherent flaws in most hospital-based initiatives and stand-alone resident curricula are the difficulties that stem from integrating rotating personnel into protocols that attempt to standardize the dynamic nature of patient care, and failing to design curricula that are tangibly connected to learners' environment and daily activities. A program that aims to improve both the hospital and the learner needs to educate trainees about hospital benchmarking metrics, have adequate support to provide continuous education of rotating trainees, and provide timely feedback for their performance within the system.

Through our hospital-initiated CDR, our vascular division recognized an opportunity to deliver fellow and resident education in a unique platform that fit the needs of a learner in the hospital, met the challenges of the hospital's vision for high-quality, value-based care, and set a precedent of shared accountability for hospital benchmarking. This study proposes that providing clear expectations and roles for rotating trainees enables participation in hospital-based QI programs through interaction with invested faculty and staff, and that integration of QI education into a specific rotation can produce real-time data and provide feedback on an individual's quality of care. Both faculty and trainees benefit from this educational experience and together can meaningfully impact hospital quality metrics, such as length of stay and clinical documentation.

The success of our program is attributed to engagement at all levels. The administrative assistance from the hospital provided foundational support, and the willingness to transparently share hospital data with physicians created a partnership which worked to solve specific process-oriented issues, as well as larger organizational problems. Additionally, the role of divisional leadership cannot be overstated. This oversight created unified efforts for both inpatient and outpatient processes and provided forward momentum for change. While individual metrics were ultimately tied to faculty, the incorporation of trainee education into daily patient care created thoughtful decision-making and illuminated variations in the care provided within the institution. An integral component of this project was our nurse practitioner, who acted as a reliable intermediary among faculty, trainees, hospital staff, and administration. The sustainability of this model relies on a solid infrastructure, consistency in patient care, and an ongoing commitment of core healthcare providers to engage rotating trainees.

Another element of the program's success was resident engagement as stakeholders. Rich dialogue about patient care was often led by the fellow and moderated by the division chief, with individual faculty available to expand the discussion as needed. Regular use of real-time data increased ownership for patients who deviated from proposed care pathways, and shared accountability

promoted open discussion of successes and failures, promoting creative problem solving to meet collective goals. This environment fostered resident education through the transmission of practical knowledge, awareness of organizational systems, and collaborative learning in authentic work settings. Trainee education was immediately applicable, continuously reinforced, and objectively measured, providing feedback for trainee performance and attention to patient care.

There are several limitations to our study that should be discussed. First, historical controls were used to assess the impact of this program, as it was not possible to evaluate DRG coding for individual patients. However, the decreased LOS was observed despite caring for more complex patients with fewer reimbursed days, as seen with an increase in CMI, yet stable GMLOS compared to controls. Although, we believe resident engagement and incorporation into a hospital based QI program contributed to overall decreased LOS and improved documentation, the effect size of this particular component of our CDR initiative cannot be individually defined. Isolated implementation of our resident education may not produce this magnitude of improvement in other settings. Compared to other divisions in our hospital that failed to demonstrate significant reductions in LOS, the results of this study emphasize trainees as front-line workers whose involvement is essential for success of hospital based QI programs. Furthermore, our division has continued to demonstrate improved LOS with an increased CMI into the next fiscal year. Another major limitation of this study was that we did not correlate improvement in CMS metrics with improvement in patient clinical outcomes such as complications, readmissions within 30 days, etc. However further analysis looking into whether CDR translates into better clinical outcomes is being investigated for a future study.

Unfortunately, this study was not designed to quantify specific improvement in learning objectives for residents. This is an inherent limitation as the current system used to evaluate resident knowledge of system-based practice is not specific to their own learning environment. Our hope is that this study demonstrates the feasibility using hospital data to provide trainees with a rich, meaningful learning experience that is grounded in Accreditation Council for Graduate Medical Education core competencies by asking trainees to evaluate their own performance. Future work should evaluate the impact of the program on both the patient and the trainees. Although decreased length of stay should translate into more efficient care, additional patient safety metrics are needed to confirm overall improvement in the quality of care. Similarly, curriculum targeting system-based practice and practice-based learning and improvement should evaluate the transferability of these skills into independent practice and the development of a commitment to lifelong continuous improvement.

CONCLUSION

Hospital-based QI initiatives traditionally target the behaviors of practicing physicians and the creation of one unified patient care team. A culture of continuous quality improvement can be created with the establishment of a QI infrastructure that educates and involves trainees as stakeholders. Assigning discrete roles to increase resident accountability supports both formal and informal resident education that can substantially impact hospital benchmarking metrics and build an environment in which all team members work together to improve patient care, while providing trainees with invaluable data for authentic learning.

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SUPPLEMENTARY INFORMATION

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