A quality improvement curriculum for the neurology clerkship: A practice-based approach to discharge education

Robert P. McInnis[a,*], Andrew J. Lee[b,d], Brian Schwartz[b], Muhammad Fazal[b], Anna Hohler[c]

[a] Brigham and Women's Hospital, Massachusetts General Hospital, Departments of Neurology, United States of America
[b] Boston University School of Medicine, Department of Neurology, United States of America
[c] St. Elizabeth's Medical Center, Department of Neurology, United States of America
[d] New York University Langone, Department of Neurology, United States of America

ARTICLE INFO

ABSTRACT

In the Neurology Clerkship at our institution, we introduced a medical education curriculum to increase student competency in providing discharge education to patients with neurologic disease, and to increase knowledge of QI principles. The curriculum was peer-based, in that it was developed by medical students, experienced by medical student clerks, and modified over time with their feedback, which was tracked using exit surveys. Patients counseled were predominantly male (67%) and white (55%), with stroke or TIA together representing the most common diagnoses (58%). A high proportion of students (> 85%) agreed that the clerkship project was effective in teaching discharge education, the risk factors for readmission, and increased confidence in providing discharge education. We conclude that medical students are poised to learn QI principals through practice-based curricula, and through practice may improve the quality and safety of care for patients with neurologic disease. This curriculum can be implemented within other services, and with different learners.

1. Introduction

Quality improvement (QI) has become a cornerstone for hospitals, reflected in mission statements that focus on access to care, improved outcomes, and patient centered care. In parallel, QI has been adopted by the Accreditation Council for Graduate Medical Education (AGME) as a required component of residency curricula. Despite this, QI has not been widely integrated into medical school training. In 2015, the Neurology Clerkship at Boston University School of Medicine introduced a student led, peer-based medical education initiative to increase competency in providing discharge education, and to build foundational knowledge of QI principles. This novel approach depended on medical student leaders, who developed the curriculum with guidance from faculty, and relied on iterative peer feedback from fellow students completing the curriculum to mold the program over time. We call this curriculum peer-based, in that it was developed by medical students, experienced by medical student clerks, and modified over time with their feedback. In this article, we describe implementation of this discharge education QI program in the Neurology Clerkship at our institution.

1.1. Background

One of QI's most important metrics, thirty-day readmission rates, identifies patients at high risk for poor outcomes. Preventing readmission rests on improved discharge education and optimized outpatient follow-up. Specifically, discharge education is one of the interventions that has been shown to help reduce overall unplanned hospital readmissions at 30 and 90 days [1] for a variety of medical conditions, which include stroke [2–6], congestive heart failure, and diabetes [7,8]. There is inherent value in training future physicians how to provide patient-centered discharge education.

A focused approach for discharge education can be developed and taught to medical students. For this project, we sought to help students learn about the factors that drive readmission for Neurology patients through a practice-based educational module [1]. To better understand what drives hospital readmissions for stroke patients, we had students review the management of evidence-based risk factors for stroke readmission with patients before discharge. Risk factors targeted in this discharge education initiative were diabetes mellitus, tobacco use, hypertension, hyperlipidemia, and prior stroke [7–11]. In addition, students were introduced to the unique factors influencing our institution's readmission rates, with the goal of further honing students'

understanding of the medical and social risk factors for readmission.

Discharge education is usually performed by an inter-professional team comprised of physicians, nurses, pharmacists, and community health coordinators. Though many medical professionals counsel patients at the time of discharge, most receive no clinical training on how to provide patient-centered discharge education. Recent published training efforts include programs on retrospective chart reviews [11,12], online discharge education modules [12,13], and hands on training [13,14] An educational module to teach discharge planning and instruction to third year students was also previously described, which used simulated cases and observer feedback [14,15].

To our knowledge, our project is novel in that it is the first peer to peer practice-based curriculum developed for students. In this study, students were required to gather all relevant discharge education elements, confirm these elements with their team, and provide discharge education to patients on the wards. The project was designed to evolve in an iterative way, based on direct student feedback.

2. Methods

2.1. Medical education element

A peer to peer medical education program was developed to teach third year Neurology Clerkship students about QI, factors that drive thirty-day readmissions, and discharge education techniques. Though the project is ongoing at the time of this writing, the study period analyzed and discussed took place between May 2015 and August 2017. Participation in the curriculum was strongly encouraged, although it was not mandatory, and students were not penalized for not participating. Likewise, patients could always opt out of the encounter Students received an overview about the learning objectives for the project, including an overview of the evidence supporting the benefits of discharge education. They were given a form to track de-identified patient information and participation. As the educational module developed, a tutorial video was developed by medical students, and was shown at the clerkship orientation to help reinforce key concepts. The learning objectives were as follows:

Learning objectives:

1. Describe the risk factors for re-hospitalization, and the importance of patient-centered discharge education.
2. Identify elements of effective patient-centered discharge education.
3. Document the results of discharge education with two patients on

the inpatient service (primary neurology, stroke, neuro ICU, emergency department, consult, or rehab).

At the end of the clerkship medical students completed an exit survey. The survey used a five-point Likert scale to determine: the effectiveness of the educational module, the overall benefit of the program to medical student education, difficulty in completing discharge education, utility of practicing discharge education as a third year student, overall communication within the team, effectiveness of student-performed discharge education, and understanding of QI. General feedback was also solicited through a free text box.

2.2. Discharge education elements

During the four week Neurology Clerkship, following the orientation sessions described above, third year students performed discharge education for two patients on an inpatient Neurology service at our institution or at four affiliated hospitals that hosted clerkship students. Students were responsible for identifying patients who were about to be discharged, performing discharge education, and documenting the discharge training. The clerkship students were asked to review the patient's medication regimen and side effects, the patient's understanding of hospitalization and illness, risk factor management, follow up appointments, and red flags. Education was provided by the student at the patient's bedside, and was observed by a resident or faculty member, when possible.

Discharge education by third year clerkship students was performed over three Plan-Do-Study-Acts (PDSA) cycles, with the third PDSA cycle currently in progress at the time of writing. In the first cycle, basic information on how to provide discharge education was provided to clerkship students via a handout. This handout both allowed medical students to collect de-identified patient information in free text form and provided a way to track student participation by their self-report. The first PDSA lasted 18 months and the second PDSA cycle lasted six months. During the second cycle, the curriculum was updated to include evidence based intervention targets that have been demonstrated to reduce 30-day readmission rates [1]. This was done to inform students about risk factors that drive readmission in real time, and to formalize their approach to discharge education. The discharge education forms given to students used a new check-list format to facilitate an organized approach to counseling. Exit surveys were also collected starting in PDSA 2. PDSA 3, which was ongoing during the writing of this article, uses a video to further inform medical students on how to
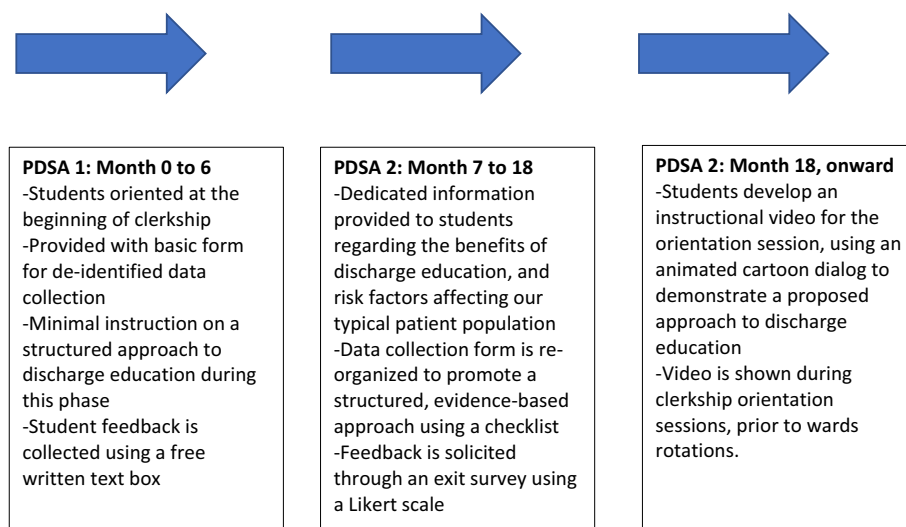

PDSA 1: Month 0 to 6
-Students oriented at the beginning of clerkship
-Provided with basic form for de-identified data collection
-Minimal instruction on a structured approach to discharge education during this phase
-Student feedback is collected using a free written text box

PDSA 2: Month 7 to 18
-Dedicated information provided to students regarding the benefits of discharge education, and risk factors affecting our typical patient population
-Data collection form is re-organized to promote a structured, evidence-based approach using a checklist
-Feedback is solicited through an exit survey using a Likert scale

PDSA 2: Month 18, onward
-Students develop an instructional video for the orientation session, using an animated cartoon dialog to demonstrate a proposed approach to discharge education
-Video is shown during clerkship orientation sessions, prior to wards rotations.

Fig. 1. The discharge education curriculum was iteratively revised through several Plan Do Study Act (PDSA) cycles, using student feedback to direct targeted changes.

properly provide discharge education. An overall schematic is provided in Fig. 1, which illustrates the evolution of the curriculum with each PDSA cycle.

2.3. Data collection and analysis

Discharge education data collection forms and exit surveys were collected at the end of the Neurology clerkships. These were used to compile demographic information and track student participation. Data was entered in a sequential manner from discharge education forms and exit surveys into their respective databases. Discharge Education data from PDSA 1 and 2 and the exit survey data from PDSA 2 was included in this study. Although there were no unique patient identifiers attached to data, it was clear in some cases that different students had selected the same patient for discharge education. Such cases were identified when two students on the same service submitted a patient with the same index diagnosis and demographic variables. In these cases, duplicate entries were excluded from summary statistics and analysis. Summary statistics were computed using Microsoft Excel.

3. Results section

3.1. Patient characteristics

During the first two PDSA cycles, 322 patients received discharge education from third year medical students on their Neurology rotation. The average age of these patients was 61.6 years. Most patients who received discharge education were male (67%) and white (55%). Other significantly represented groups who received discharge education were African Americans (21%) and Hispanics (14%). English was the primary language in 73% of patients who received discharge education; only 7% of patients reported Spanish as their primary language. Interpreters were used in 11% of cases. Patients who received discharge education stayed in the hospital on average 4.1 days (SD 4.31).

Patients who received discharge education were stratified into six general diagnosis categories. Stroke (hemorrhagic and ischemic types) was the most common index diagnosis for admitted patients who received discharge education (48%). Other common index diagnoses included transient ischemic attack (TIA) (10%), seizure (11%), migraine (4%), and multiple sclerosis (2%). "Other diagnoses" represented 25% of patients who received discharge education, and included a wide range of possible reasons for admission: dizziness, delirium, demyelinating disease, peripheral neuropathy, spinal stenosis, substance use disorders, headache, Parkinson's disease, radiculopathy, and possible seizures were among the most common in this category.

We also tracked patient comorbidities that were shown to influence readmission rates if they were discussed during discharge education. Hypertension was the most common comorbidity (62%) in patients who received discharge education. Other common comorbidities included hyperlipidemia (39%), diabetes mellitus (22%), tobacco use (16%), substance use (4%), and prior stroke (2%).

3.2. Discharge education results

Medical students were instructed to provide discharge education that comprised of five distinct elements: Medication review, review of the patient's understanding of his illness and hospitalization, review of risk factors, review of follow up appointments, and review of red flags after discharge. Through PDSA1 and PDSA2, 95% of patients received discharge education for one or more elements (Table 1). The average number of elements covered by students performing discharge education was 1.8 (SD 1). Review of the patient's comorbidities at discharge was the most commonly completed element, with 55% of patients receiving education about how their comorbidities contributed to their admission and how they place the patient at increased risk for readmission. Review of medication regimens, including changes and side

Table 1

Student self-reported results of discharge education.

Total patients	322
Average # of completed elements (SD)	1.8 (1.0)
	%
≥ 1 element	95
Medication education	49
Review understanding of illness and/or hospitalization	34
Review risk factors	55
Review follow up appointments	20
Review Red flags	23
Completed elements %	%
0	8
1	31
2	39
3	18
4	4
5	1

Overall results of discharge education based on student self-report. Data reflects PDSA 1 and PDSA 2, at both home and affiliate institutions.

effects, was the second most commonly completed topic (49%). Most patients received discharge education in two of the five above elements (39%). Only 1% of patients received discharge education on all five elements. Interpreters were used in 11% of patients receiving discharge education. Overall, 52% of patients had a Neurology follow up appointment scheduled at discharge. Of the patients with a Neurology follow up appointment scheduled by the time of discharge, 26% of them had their Neurology follow up reviewed with them by a student. For patients who were discharged at night or on weekends, appointments were provided by clinic staff via phone call after discharge and were not included in the student's discharge education.

Two PDSA cycles were completed. In PDSA 1, a form was given to students at the start of their Neurology Clerkship that briefly described the principles of QI, the elements of discharge education, and how to perform discharge education. PDSA 2 was notable for a change in the discharge education tracking form, to include a checklist of the evidence based discharge education elements [1]. The main goals of this change were to teach students about factors that contribute to readmission and to formalize their approach to discharge education.

A total of 254 students were eligible to participate in the QI discharge education initiative during PDSA 1 and PDSA 2, with a participation rate of 72.8% (n = 185). While students were encouraged to provide discharge education to two patients each, the average number of patients counseled per medical student was 1.74. Students who provided discharge education were evenly distributed between home and affiliate institutions, with 49.7% of participating students coming from our home institution.

Through PDSA 1, 287 patients received discharge education. Almost all patients received education on 1 or more elements during PDSA 1 (97%). The average number of completed elements was 1.79 (SD 0.99). Review of risk factors was most commonly completed (55%). During PDSA 1, review of medication changes and side effects, understanding of illness and hospitalization, red flags, and follow up appointments were completed 49%, 30%, 24%, and 22% of the time, respectively. In terms of completed elements, 39% of patients received discharge education on two of the above elements, while 32% received education on one element. Only 1% of patients received discharge education on all five targeted elements. Interpreters were used with 11% of patients.

Through PDSA 2, 32 patients received discharge education. During this PDSA cycle, 88% of patients received discharge training in one or more education elements. The average number of completed elements was 1.91 (SD 1.1). Review of illness and hospitalization was the most commonly completed element (72%). Medication education and review of risk factors were also frequently completed, 50% and 47%, respectively. Review of follow up appointments and red flags were completed at 13% and 16%, respectively. Three elements were completed in 31%

Table 2
Student discharge education with each PDSA cycle.

Average number of completed elements	
PDSA 1 (SD)	1.79 (0.99)
PDSA 2 (SD)	1.91 (1.1)

Proportion of students completing each discharge education element			
Student reviewed	PDSA1	PDSA2	p-value
Medication education	0.49	0.50	0.9436
Understanding of Hosp/Illness	0.30	0.72	< 0.0001
Risk factors	0.55	0.47	0.2623
Follow up	0.22	0.13	0.2084
Red flags	0.24	0.16	0.2762

Changes in discharge education between PDSA 1 (n = 115) and PDSA 2 (n = 70).

of patients, while two elements were completed in 38% of patients. During PDSA 2, interpreters were used 6% of the time. The proportion of patients who had a Neurology follow up appointment at discharge was 53%.

Through the course of the study there was a statistically significant 42% increase in students reviewing with patients why they were hospitalized and their understanding of their illness (Table 2, $p < .0001$). Between PDSA 1 and PDSA 2, the number of discharge education elements completed increased from 1.79 to 1.91 (Table 2). However, this change was not statistically significant (two-sample t-test, $t = 0.63$, $p = .529$). Of note, the proportion of students who turned in tracking forms without completing discharge education also increased by 9% during PDSA 2. Other measures of comparison between PDSA 1 and PDSA are summarized in Table 2.

3.3. Student attitudes

Exit surveys were collected from students after they completed discharge education, starting with PDSA 2. Overall, 42 of 75 eligible students returned a survey, representing a 56% response rate. Students were asked a series of questions to gauge the effectiveness of the practice based educational module, with their responses summarized in Table 3. Most students responded positively when asked whether practicing discharge education was a useful exercise (81%) and whether it was overall beneficial to their education (79%). Most respondents reported that they felt more confident in being able to provide effective discharge education to patients with neurologic conditions after participating (91%). Students also felt that practicing

discharge education in this project helped them deliver more effective discharge education (88%). Finally, most students felt that they had a better understanding of risk factors that influenced hospital readmissions after completing their discharge education project. Students' attitudes towards QI were assessed in the exit survey. Overall, 55% of students reported that the project gave them a better understanding of QI. Students also generally responded positively when asked whether they felt that they could reduce readmission rates by providing effective discharge education (64%). They found that instructions for providing discharge education were clear (88%), and that there was strong communication within the team with respect to discharge education and participation in the discharge education initiative (72%).

4. Discussion

We describe the implementation of a novel, peer led QI curriculum in the Neurology Clerkship at our institution, which met with positive feedback from students, and achieved the defined learning objectives. This peer to peer QI discharge education module may be effective on other inpatient services, and with different learners. In addition to helping hone discharge education skills, this module will help learners understand factors that drive readmission. It is a model that can be modified over time based on feedback to address learning needs and barriers to implementation.

Our data suggest that it can be challenging for students to complete all of the elements of comprehensive discharge education. We presume there were multiple factors influencing this result that were not captured by the exit survey. Among factors intrinsic to students, time and motivation to fully engage in the project may have been stifled to an extent by competing academic interests, as well as survey fatigue. Further, we note that 38% of our students reported relative difficulty finding patients to counsel and, as a possible result, often chose to follow complex patients (Table 3). Although the majority of counseled patients were admitted with stroke or TIA, a sizeable portion fit into alternative diagnostic categories, including "other," which may have included patients with more diagnostic complexity or uncertainty. Such patients may have been more challenging for students from a counseling perspective. There is exciting opportunity within the realm of non-vascular neurology to develop more standard approaches to transitions in and out of the hospital, particularly for common index neurologic diagnoses like multiple sclerosis and seizure. Neurology clerkship students could gain further practice-based learning and learn more about these neurologic illnesses by counseling patients about possible medication effects, titration regimens, and the natural history of the disease. The curriculum could be developed further by developed standard video-based vignettes specific to these common neurologic

Table 3
Exit survey summary statistics.

Question	% Positive response[a]	Average response[b]
(Q1) I had little difficulty finding patients with whom I could complete this project	61.9%	3.5
(Q2) Once I found patients, I thought the instructions for providing discharge education and completing this project with the patients were clear.	88.1%	4.2
(Q3) I learned how to provide more effective discharge education by practicing it with patients during this rotation.	88.1%	4.1
(Q4) My understanding of quality improvement increased as a result of this project.	54.8%	3.6
(Q5) After completing this project, I feel that students can reduce readmission rates by providing effective discharge education to patients.	64.3%	3.8
(Q6) I feel more confident in providing effective discharge education to patients with neurologic conditions.	90.5%	4.2
(Q7) I have a better understanding of the risk factors that influence hospital readmission after completing this project.	83.3%	4.1
(Q8) I felt there was strong communication with my team regarding discharge planning as I completed this project	71.4%	3.9
(Q9) Practicing discharge education during this rotation was a useful exercise.	81.0%	4.1
(Q10) This project was overall beneficial to my education.	78.6%	4.1

Exit survey questions posed to students at the end of their rotation, with the percent of positive response, as well as average response across students. A Likert scale was used to track a student's response to each question, with 1 representing strongly disagree to 5 representing strongly agree.
[a] A positive response was defined as a response ≥ 4.
[b] Average response was calculated as the average Likert response for each question.

diseases. Medical students should be encouraged to review the subtleties pertinent to each patient with a resident on their team, prior to in person practice.

Future PDSA cycles should set to achieve higher full completion rates among students, with more oversight and support from both residents and faculty representing a reasonable first step. This could include one mandatory observed discharge education interaction between a student, patient and faculty member or resident, with ongoing auditing from involved peer leaders. With a growing focus on developing physicians equipped to improve the quality and delivery of medical care, medical schools must continue to find ways to integrate QI education into clinical training.

Acknowledgments

References

[1] E.A. Coleman, C. Parry, S. Chalmers, S.-J. Min, The care transitions intervention: results of a randomized controlled trial, Arch. Intern. Med. 166 (2006) 1822–1828, https://doi.org/10.1001/archinte.166.17.1822.

[2] A.N. Russo, G. Sathiyamoorthy, C. Lau, D. Saygin, X. Han, X.-F. Wang, R. Rice, L.S. Aboussouan, J.K. Stoller, U. Hatipoğlu, Impact of a post-discharge integrated disease management program on COPD hospital readmissions, Respir. Care (2017), https://doi.org/10.4187/respcare.05547.

[3] F.C. Robertson, J.L. Logsdon, H.H. Dasenbrock, S.C. Yan, S.M. Raftery, T.R. Smith, W.B. Gormley, Transitional care services: a quality and safety process improvement program in neurosurgery, J. Neurosurg. (2017) 1–8, https://doi.org/10.3171/2017.2.JNS161770.

[4] M.I. Puhr, H.J. Thompson, The use of transitional care models in patients with stroke, J. Neurosci. Nurs. 47 (2015) 223–234, https://doi.org/10.1097/JNN.0000000000000143.

[5] P. Kitzman, K. Hudson, V. Sylvia, F. Feltner, J. Lovins, Care coordination for community transitions for individuals post-stroke returning to low-resource rural communities, J. Community Health 42 (2017) 565–572, https://doi.org/10.1007/s10900-016-0289-0.

[6] J. Gassaway, M.L. Jones, W.M. Sweatman, M. Hong, P. Anziano, K. DeVault, Effects of peer mentoring on self-efficacy and hospital readmission after inpatient rehabilitation of individuals with spinal cord injury: a randomized controlled trial, Arch. Phys. Med. Rehabil. 98 (2017) 1526–1534.e2, https://doi.org/10.1016/j.apmr.2017.02.018.

[7] T.M. Koelling, M.L. Johnson, R.J. Cody, K.D. Aaronson, Discharge education improves clinical outcomes in patients with chronic heart failure, Circulation 111 (2005) 179–185, https://doi.org/10.1161/01.CIR.0000151811.53450.B8.

[8] S.J. Healy, D. Black, C. Harris, A. Lorenz, K.M. Dungan, Inpatient diabetes education is associated with less frequent hospital readmission among patients with poor glycemic control, Diabetes Care 36 (2013) 2960–2967, https://doi.org/10.2337/dc13-0108.

[9] X. Zhong, B. Huang, J. Feng, W. Yang, H. Liu, Delayed leukoencephalopathy of non-small cell lung cancer patients with brain metastases underwent whole brain radiation therapy, J. Neuro-Oncol. 125 (2015) 177–181, https://doi.org/10.1007/s11060-015-1888-9.

[10] A. Rao, E. Barrow, S. Vuik, A. Darzi, P. Aylin, Systematic review of hospital readmissions in stroke patients, Stroke Res. Treat. 2016 (2016) 9325368, , https://doi.org/10.1155/2016/9325368.

[11] J.H. Lichtman, E.C. Leifheit-Limson, S.B. Jones, E. Watanabe, S.M. Bernheim, M.S. Phipps, K.R. Bhat, S.V. Savage, L.B. Goldstein, Predictors of hospital readmission after stroke: a systematic review, Stroke 41 (2010) 2525–2533, https://doi.org/10.1161/STROKEAHA.110.599159.

[12] J. Moran, C.Y. Colbert, J. Song, J. Hull, S. Rajan, S. Varghees, A.C. Arroliga, S.P. Reddy, Residents examine factors associated with 30-day, same-cause hospital readmissions on an internal medicine service, Am. J. Med. Qual. 28 (2013) 492–501, https://doi.org/10.1177/1062860613480827.

[13] M.A. Eskildsen, Review of web-based module to train and assess competency in systems-based practice, J. Am. Geriatr. Soc. 58 (2010) 2412–2413, https://doi.org/10.1111/j.1532-5415.2010.03167.x.

[14] K.A. Booth, L.M. Vinci, J.L. Oyler, A.T. Pincavage, Using a resident discharge clinic for resident education and patient care: a feasibility study, J. Grad. Med. Educ. 6 (2014) 536–540, https://doi.org/10.4300/JGME-D-13-00313.1.

[15] M. Lyons, B. Miles, A. Davis, M. Saathoff, A. Pincavage, Preventing Breakdowns in Communication: Teaching Patient-Centered Posthospital Care Transitions to Medical Students, 12 MedEdPORTAL Publ., 2016, https://doi.org/10.15766/mep_2374-8265.10435.