Facilitating Early-In-Day Discharge for Multiple Sclerosis Patients Treated With Intravenous Methylprednisolone: A Quality Improvement Project

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Abstract

Background and Purpose: Delays in patient hospital discharge affect care value through costs of prolonged length of stay and barriers to patient flow within the hospital. We sought to facilitate early-in-day discharges (EIDDs) without extending length of stay for inpatients with multiple sclerosis admitted for acute exacerbations and treated with intravenous (IV) methylprednisolone. **Methods:** We developed a standardized admission order set, a provider checklist, and a patient checklist to better coordinate in-hospital care and discharge planning for patients with multiple sclerosis admitted for IV methylprednisolone treatment. The order set allowed providers to enter an accelerated dosing schedule of methylprednisolone, as appropriate, to ensure administration of the final dose of methylprednisolone in the morning on the anticipated day of discharge. We compared a prospective intervention cohort to a retrospective, preintervention baseline cohort. **Results:** At baseline ($N = 25$), 12.0% of patients were EIDD compared to 40.7% of intervention patients ($N = 27$; $P = .03$). In all, 85.2% of intervention patients compared to 64.0% of baseline patients were discharged on the same day as last methylprednisolone treatment ($P = .11$). No difference was observed in median length of stay and 30-day readmission rate between groups. **Conclusions:** Use of a standard admission order set as well as provider and patient checklists can facilitate EIDD and hospital bed availability without compromising care quality for a select group of neurology inpatients.

Keywords

multiple sclerosis, quality

Introduction

Early-in-day discharge (EIDD) of inpatients has been proposed as a means of helping to alleviate patient flow bottlenecks from emergency departments and potentially decreasing patient length of stay while also improving patient and staff satisfaction.^{1,2} Delays in hospital discharge can also affect patient movement from critical care and postoperative care units, and if persistent, lead to cancellation of elective admissions and procedures and the diversion of patients from emergency departments.^{3,4} There are, however, many barriers to EIDD from the hospital.⁵⁻⁷ Studies on facilitating EIDD have focused on systematic preparation for discharge beginning

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prior to the anticipated discharge date, involving members of the care team (including physicians) as well as patients.^{4,8-10} We set out to develop interventions to better coordinate the course of hospital admission to facilitate EIDD for neurology inpatients specifically. As care for patients admitted for acute exacerbations of multiple sclerosis includes relatively standardized treatment with intravenous (IV) steroids,^{11,12} we focused on this subset of patients to study the effect of candidate interventions in facilitating EIDD with particular focus on planning for discharge from time of admission.

Methods

Setting, Intervention Development, Patients, Study Design, and Analysis

Setting. This study was conducted on 2 mixed neurology and neurosurgery acute care units (total of 88 beds) at the Johns Hopkins Hospital, an academic medical center. The general neurology service is an academic service with rotating medical students, residents, and attending faculty as well as a physician assistant. Multidisciplinary care is delivered by the neurology physician team; nurses; clinical support staff; physical, occupational, and speech language therapists; dietitians and pharmacists.

Intervention development. A neurology-specific team composed of nursing staff, social workers, therapists, discharge coordinators, administrators, house staff, a physician assistant, attending physicians, hospital patient safety and quality improvement coordinators, and departmental leadership was formed. The focus of this group was to facilitate EIDD by understanding the course of hospitalization of neurology patients, develop metrics to understand the course of hospitalization and monitor for intervention effects, and develop interventions to help care team members and patients prepare for discharge from the time of admission. This project was undertaken among concurrent initiatives within the departments of neurology and neurosurgery to facilitate EIDD such as the reorganization of multidisciplinary rounds.

Patients with multiple sclerosis admitted for treatment of acute exacerbations with IV methylprednisolone were selected as the population of focus as they follow a standard treatment course and hospitalization pathway with frequent discharge home.^{11,12} Applying Lean Six Sigma methodology, a process map for hospitalization from time of emergency department presentation, and admission to discharge was developed based on a 2-month sample of 17 patients. In addition, a process map for the discharge process was developed, from final methylprednisolone infusion to discharge and bed availability (Figure 1).

Using the process map of hospitalization course, irregular practice in scheduling of IV methylprednisolone doses as well as time from final physical, occupational, and speech language therapy assessment to formalization by social work discharge

plan were identified areas of inefficiency. Our group practice is for administration of doses of methylprednisolone on an accelerated 20-hour schedule to allow advancement of administration times through the course of hospitalization; however, this was irregularly followed, with median dose intervals of 22.5 hours. In addition, we noted a time period of median 66 hours from request for physical, occupational, and speech/language therapy assessments to completion of recommendations and finalization of posthospitalization plans by departmental social workers. This was interpreted as the result of ineffective communication between members of the care team. As regards day of discharge activities, time from final steroid administration to bed availability was noted to be variable with various delays including nursing checks, discharge paperwork completion, discharge order entry, and documented discharge with bed availability. Consistent with prior reports, a limited review of discharge delays within our department identified arrangement of patient transportation home, coordination of discharge with patient and family, and resolution of patient health concerns as common reasons for delay.^{6,13,14}

Based on discussions with house staff, a dedicated admission order set within the institutional electronic provider order entry system for the administration of IV methylprednisolone to patients with acute multiple sclerosis exacerbations was developed (Figure 2). The order set was designed for entry at time of patient admission to coordinate anticipated care activities. The order set also generated nursing instructions for distribution of a patient checklist and informational handout on the use of IV methylprednisolone for acute multiple sclerosis exacerbations. A provider checklist was developed based on the process maps for use during care coordination rounds and by the care team to monitor progress of care and discharge planning (Figure 3A). This checklist was incorporated by house staff into electronic handoff documents used by all care team members through the electronic medical record system. A patient information sheet on the use of IV methylprednisolone and a patient checklist (Figure 3B) to facilitate patient self-monitoring of care and discharge preparation were composed, adjusting language to a sixth grade level per hospital policies.

Patients. Patients were identified through review of electronic medical records. Included patients were greater than 18 years of age, admitted to the general neurology service to a neurosciences acute care unit bed with diagnosis of multiple sclerosis (*International Classification of Diseases, Ninth Revision* [ICD-9] 340), and treated with IV methylprednisolone during their admission. Patients were excluded if they received plasmapheresis during their admission. To ensure sample independence and prevent overrepresentation, only the first (index) admission for a given patient for administration of IV methylprednisolone within the baseline or intervention periods was included.

Study design and analysis. The intervention group was a prospectively collected sample of consecutive patients during a

Figure 1. Process map of hospital course and discharge process for sample of patients with multiple sclerosis treated with intravenous methylprednisolone for acute exacerbations.

7-month intervention period (September 1, 2013 to March 31, 2014). This intervention group was compared to a retrospective baseline cohort of consecutive patients discharged during a 6-month period preceding planning of departmental and unit-wide EIDD initiatives (March 1, 2012 to August 30, 2012).

Data were collected from administrative databases and the electronic medical record. The EIDD was defined as the patient having physically left the hospital prior to 2:00 PM per discussions with neurology residency and departmental leadership. Demographic data included patient age, gender, race, and ability to ambulate without assistance at time of admission. All Patient Refined Diagnosis-Related Group (APR-DRG) severity of illness level, APR-DRG complexity of care level, and discharge disposition. Outcome measures included length of stay in days, elapsed time from therapy request to first therapy assessment in minutes, elapsed time from when final methylprednisolone infusion was begun to discharge in minutes, frequency of beginning final methylprednisolone infusions before 8:00 AM, frequency of discharge before 2:00 PM, frequency of discharge on the same day as last methylprednisolone infusion, and frequency of arrangement of home IV methylprednisolone infusions. The time last methylprednisolone infusions were begun and discharge times were converted to minutes-after-midnight to allow for comparisons of time of last infusion beginning to discharge time

between groups.⁸ Frequency of 30-day readmissions for study patients was used as a measure of care quality. To account for other concurrent departmental and care unit EIDD initiatives during the intervention time period, baseline and intervention group EIDD frequencies were compared to those for all general neurology patients who did not meet study inclusion criteria discharged during the respective periods.

This study was approved by the Johns Hopkins School of Medicine Institutional Review Board with approval for nursing participation through the Johns Hopkins Hospital Department of Nursing. Medians and interquartile ranges (IQRs) were calculated for continuous variables and compared using the Wilcoxon-Mann-Whitney test. Proportions were determined for categorical variables and compared using Pearson χ^2 and Fisher exact test as appropriate. All statistical analyses were performed using the SPSS (version 22, IBM, Armonk, New York) statistical software package. Two-tailed statistical significance was assessed at the $P < .05$ level.

Results

Patients

During the baseline period, 26 patients were admitted with 25 index admissions for acute multiple sclerosis exacerbation and

NEURO Multiple Sclerosis Steroid - CAT, DIRTY

CAT, DIRTY 2-557-69-80 / 515982460 38y (01/03/1975) Male
12 East-043-A FRANK, DANA
Allergies: No Known Allergies

Multiple Sclerosis Steroid Order Set [33 orders of 150 are selected]

Pharmacy	Order	Dose	UOM	Route	Frequency	PRN	PRN Reason	Start Date	Start Time	Priority	Instructions/Co
Pharmacy - 7 item(s)	☒ methylPREDNISolone Inj	1	g	IV	q24h	☐		02/14/2013	Now & Routine		
	☒ methylPREDNISolone Inj	1	g	IV	once	☐		02/15/2013	18:00		
	☒ methylPREDNISolone Inj	1	g	IV	once	☐		02/16/2013	14:00		
	☒ methylPREDNISolone Inj	1	g	IV	once	☐		02/17/2013	10:00		
	☒ methylPREDNISolone Inj	1	g	IV	once	☐		02/18/2013	06:00		
	☐ Ranitidine Enteral	150	mg	PO	bid	☐			Routine		
	☐ Acetaminophen Enteral	650	mg	PO	q4h	☒	Pain		Routine		Max 4000mg A

IV Therapy

☒ Peripheral IV Catheter Orderset (4 orders of 4 selected)

Lab

☐ Basic Metabolic Panel LAB ☐ Heme-B LAB ☐ Hemoglobin A1C LAB

Radiology

☐ MRI Brain w/ diff w/wo IV Cntrst ☐ MRI C-T Spine w/wo IV Contrast ☐ Chest AP

Figure 2. Screenshot of intervention order set entered in electronic medical record for a fictitious training patient. The order set included a separate order for each individual dose of methylprednisolone, each to be administered at times specified by the ordering provider. Providers were instructed to time orders for advancement of doses at an every 20-hour schedule to ensure final dose administration in the morning of anticipated day of discharge. Areas of entry of separate orders were provided as on occasion patients are admitted at times that already allow for early administration of methylprednisolone or where advancement of doses need occur for only a few doses. Providers were instructed to avoid overnight administrations for concern of interrupting patient rest and the stimulating effects of steroids. The order set also included standard admission, nursing, house officer notification, venous thromboembolism prophylaxis, vaccination, activity, and nutrition orders. It also included orders for basic laboratory assessments (basic metabolic panel, complete blood cell count, hemoglobin A1C, and urine analysis) and radiographic studies (multiple sclerosis-specific magnetic resonance imaging studies of the brain and cervical and thoracic spine as well as chest radiograph) to be ordered as appropriate. Finally, it included orders for gastric ulcer prophylaxis and analgesia and consultations for physical therapy, occupational therapy, speech language pathology, nutrition, and social work to be selected as appropriate.

treatment with IV methylprednisolone. Twenty-eight patients were admitted with 27 index admissions during the intervention period for the administration of IV methylprednisolone. The baseline and intervention groups were well matched in terms of age, gender, race, disposition, ability to ambulate without assistance at time of admission, severity of illness, and complexity of care (Table 1). There was no difference in the median number of methylprednisolone infusions for the baseline and intervention groups (3 [IQR 2] and 3 [IQR 2.5], respectively; $Z = -0.068$, $P = .95$). During the intervention period, the intervention order set was used for 20 (74%) patients while the provider checklist was used for 16 (59%) patients. Neither intervention was used for 5 (19%) patients.

Hospital Course

The length of stay for the baseline and intervention groups was similar (3.58 days [IQR 2.61] and 3.46 days [IQR 2.25],

respectively; $Z = -6.50$, $P = .52$). There was no difference in proportions of patients for whom home infusions were arranged for the baseline (16.0%) and intervention (18.5%) groups ($P = 1.00$, Figure 4).

Discharge Process

At baseline, 16 (64.0%) patients were discharged on the same day as their final methylprednisolone dose, and there was a trend to this increasing among the intervention group patients (85.2%; $P = .11$, Figure 4). In all, 3 (12.0%) baseline group patients and 12 (44.4%) intervention group patients received their final infusion of methylprednisolone before 8:00 AM ($P = .01$, see Figure 4). The median administration time of methylprednisolone for the intervention group was 8:00 AM (IQR 300 minutes) compared to 11:30 AM (IQR 384 minutes) for the baseline group ($Z = -2.84$, $P = .005$). The median time from final

A.

- ☐ Date and Time of First Steroid Dose (MM/DD HH:MM)
- ☐ Date and Time of Last Steroid Dose (MM/DD HH:MM)
- ☐ Urine Analysis Complete
- ☐ Chest X-ray Complete
- ☐ MRI Complete
- ☐ Therapy requests made as appropriate
- ☐ Therapy evaluations complete
- ☐ Therapy placement made, as appropriate
- ☐ Home care assessment complete
- ☐ Transportation home coordinated with patient for before noon on last day of steroids (MM/DD)
- ☐ Medication reconciliation complete
- ☐ Prescriptions complete
- ☐ Follow-up appointments arranged
- ☐ Discharge worksheet complete
- ☐ Discharge order entered

B.

Dear Patient,

Thank you for letting us to care for you. Please use this list to track the course of your care, to help us meet your medical needs, and to prepare for a safe discharge on the same day you complete your steroid dose.

Date of Last Steroid Dose and Expected Discharge Date:

- ☐ MRI Complete
- ☐ Therapy consults, as needed
- ☐ Plan for a ride home before noon on the day of final steroid dose
- ☐ Your home medicines and any medicine changes were reviewed with you
- ☐ Needed medicine prescriptions from this hospital stay are complete
- ☐ Information for follow-up appointments
- ☐ All questions and concerns about your health care needs, your medicines, your own health management, and what to expect after leaving the hospital have been answered.

Please use the space below to write down questions you have:

Figure 3. Provider and patient checklists. A, The provider checklist was designed to facilitate discharge preparation by including the date and time of anticipated final dose of methylprednisolone of anticipated discharge as well as other items related to assessments anticipated to occur through the course of hospitalization and steps to be completed in preparation for discharge to facilitate safe care transition from the inpatient setting. B, To facilitate communication of planned day of discharge, a patient checklist was developed, which included a statement of the anticipated date of final methylprednisolone dose administration and discharge. It also included items to allow patients to monitor the course of their hospitalization (eg, MRI completion) as well as to prompt discussions relevant to safe and well-coordinated discharge including coordination of transportation home on day of anticipated discharge, medication reconciliation, filling of needed prescriptions, provision of follow-up care information, and resolution of patient health concerns. MRI indicates magnetic resonance imaging.

Table 1. Characteristics of the 52 Patients in the Baseline or Intervention Groups.

	Baseline (N = 25)	Intervention (N = 27)	P
Median age, years (IQR)	33 (20.5)	35 (21)	.68
Female, N (%)	15 (60)	21 (78)	.17
Race			.31
African American, N (%)	16 (64)	13 (48)	
White, N (%)	7 (28)	13 (48)	
Other, N (%)	2 (8)	1 (4)	
Ambulatory without assistance at admission, N (%)	17 (68)	19 (70)	1.00
Discharge to home, N (%)	21 (84)	24 (89)	.61
Median APR-DRG severity (1 [low]-4 [high]), (IQR)	2 (0)	2 (0)	1.00
Median APR-DRG care complexity (1 [low]-4 [(high)], (IQR)	2 (1)	2 (1)	.73

Abbreviations: APR-DRG, All Patient Refined Diagnosis-Related Group; IQR, interquartile range.

Figure 4. Outcome measure proportions for baseline and intervention groups.

methylprednisolone dose administration beginning to discharge did not vary between the baseline (542 minutes, IQR 1159) and intervention groups (500 minutes, IQR 334; $Z = -0.824$, $P = .41$; Figure 5).

Time of Discharge

Of the intervention group patients, 11 (40.7%) experienced EIDD compared to 3 (12.0%) of the patients at baseline ($P = .03$, Figure 4). The median time of discharge for the intervention group was 3:24 PM (345 minutes) compared to 4:43 PM (IQR 212 minutes) for the baseline group ($Z = -1.14$; $P = .25$).

Comparison With General Neurology Population

The EIDD proportion for all baseline group patients (12.0%) was the same as for all other general neurology patients during the same time period (17.8%; $P = .59$). In the intervention period, the EIDD proportion for the intervention group patients (40.7%) was greater than that for all other general neurology

Figure 5. Standardization of discharge process. Although median time from beginning final methylprednisolone infusion to discharge did not vary between the baseline and intervention groups, the discharge process became more reliable as demonstrated by decrease in interquartile range of the intervention group relative to baseline.

patients (19.2%; $P = .01$). There was no difference between the EIDD proportion for all other general neurology patients in the baseline and intervention time periods ($P = .65$).

Rate of Readmission

The 30-day readmission rates for the baseline and intervention groups were similar (12.0% and 7.7%, respectively; $P = .67$, Figure 4).

Discussion

We present a quality improvement project that led to a greater than 3-fold increase in the EIDD proportion for patients with multiple sclerosis admitted for treatment of an acute exacerbation with IV methylprednisolone. There was a trend

toward an earlier median time of discharge, comparable to other EIDD interventions.^{4,10} This increase in EIDD proportion occurred in the setting better coordination of discharge day activities, specifically early-in-day administration of the final methylprednisolone dose. Preparation for this early dose administration was made at time of admission through order entry using the developed intervention order set. Although there was no difference in the median times from final methylprednisolone infusion to discharge between the baseline and intervention groups, the narrowing of the IQR for the intervention group suggests a more standard discharge process. Importantly, the observed increased EIDD proportion was not at the expense of care quality, with no effect on 30-readmission frequency noted.

Cost of care is the denominator of the value of care equation, encompassing the costs associated with treatments, facilities, and services in care provision.¹⁵ In addition, there is an opportunity cost in lost hospital revenue for patients awaiting beds for admission or within-hospital transfers.¹⁴ This project is a proof-of-concept in that the coordination of care from time of admission to discharge can lead to EIDD for a specific non-cerebrovascular inpatient neurology population, thus creating value by process improvement. This concept has the potential for extension to other diseases and interventions, such as the coordination of plasmapheresis for patients with multiple sclerosis or myasthenia gravis exacerbations.

One concern regarding an emphasis on EIDD is the motivation to keep patients an additional night and discharge the next day, even when medically ready for discharge. This would lead to improve rates of EIDD at the cost of increasing length of stay. This was not observed as length of stay did not change between the baseline and intervention groups. Rather, there was a trend to an increase in the proportions of discharges on the same day as final methylprednisolone infusion.

Although a patient checklist was designed to facilitate the discharge planning process from time of admission, patient completion of this checklist was not ascertained and patient-specific reasons for discharge delay were not captured. Both the reasons for discharge delay and the efficacy of a patient discharge preparation checklists warrant further exploration. Finally, though there was a reduction in the variability of time from final treatment beginning and discharge in the intervention group relative to the baseline group, the observed greater than 8-hour interval for the discharge process warrants further investigation and intervention.

This study is limited in that it was performed at a single academic medical center with focus on a subset of the inpatient neurology population with inherent limitations on generalizability. The small sample sizes limit the ability to fully assess the influence of various providers on the observed rates of intervention utilization and EIDD. It should be noted that attending neurologists and residents typically rotated every 2 to 4 weeks, and the sample size limited the ability to compare physician-specific influences on the observed outcomes. This study was designed to evaluate EIDD and did not

evaluate patient nor provider satisfaction. However, unlike prior studies of interventions on EIDD,⁸ a measure for care quality and safety was included (30-day readmission rate).

Finally, this quality improvement project was performed in concert with other department and care unit wide interventions to facilitate EIDD. The effect that such interventions may have had on the observations presented here is difficult to isolate given our sample size. The retrospective baseline group was defined to minimize possible confounding effects of other ongoing interventions and conversations. By comparing the rates of EIDD for the general neurology inpatient population not included in the study in the baseline and intervention periods, an impression of the relative contribution of the intervention to EIDD frequency in the context of other concurrent interventions is presented. Despite concurrent institutional EIDD efforts, the intervention presented here led to an increase in EIDD proportion for the target patient population relative to both a baseline comparison sample and the general population of patients discharged from the neurology inpatient service during the intervention time period.

Conclusion

In a single-center study of a prospective intervention sample with comparison to a retrospective baseline, the use of a standard admission order set and provider as well as patient checklists facilitated EIDD without compromising care quality for a select group of neurology inpatients.

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Declaration of Conflicting Interests

The authors declared the following potential conflicts of interest with respect to the research, authorship, and/or publication of this article: He serves as a consultant for Chugai Pharmaceuticals, Glaxo-Smith-Kline, and MedImmune.

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