Optimizing Neurology Inpatient Documentation: A Pilot Study of a Novel Discharge Documentation EHR Tool

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Abstract

Background and Purpose: Clinical documentation of patient acuity is a major determinant of payer reimbursement. This project aimed to improve case mix index (CMI) by incorporating a novel electronic health record (EHR) discharge documentation tool into the inpatient general neurology service at the University of California, Los Angeles (UCLA) Medical Center. **Methods:** We used data from Vizient AMC Hospital: Risk Model Summary for Clinical Data Base (CBD) 2017 to create a discharge diagnosis documentation tool consisting of dropdown menus to better capture relevant secondary diagnoses and comorbidities. After implementation of this tool, we compared pre- (July 2017-June 2019) and post-intervention (July 2019-June 2021) time periods on mean expected length of stay (LOS) and mean CMI with two sample T-tests and the percentage of encounters classified as having Major Complications/Comorbidities (MCC), with Complication/Comorbidity (CC), and without CC/MCC with tests of proportions. **Results:** Mean CMI increased significantly from 1.2 pre-intervention to 1.4 post-intervention implementation ($P < .01$). There was a pattern of increased MCC percentages for "Bacterial infections," "Other Disorders of Nervous System", "Multiple Sclerosis," and "Nervous System Neoplasms" diagnosis related groups post-intervention. **Conclusions:** This pilot study describes the creation of an innovative EHR discharge diagnosis documentation tool in collaboration with neurology healthcare providers, the clinical documentation improvement team, and neuro-informaticists. This novel discharge diagnosis documentation tool demonstrates promise in increasing CMI, shifting diagnosis related groups to a greater proportion of those with MCC, and improving the quality of clinical documentation.

Keywords

general neurology, quality improvement, quality outcomes, electronic health record, documentation

Introduction

Multiple studies have demonstrated that the complexity of hospitalized patients may not be accurately characterized in discharge documentation coding, and that this inaccuracy may be associated with a loss of reimbursement to the hospital.[1,2] The documentation of additional diagnoses on discharge or other medical comorbidities may also be lacking.[3] A number of quality improvement initiatives have been developed to address and improve inaccurate discharge documentation, including direct feedback mechanisms,[4-6] the use of discharge summary templates and evaluation instruments,[7-9] and educational curricula.[9]

Clinical documentation is a prominent determining factor of patient acuity and payer reimbursement. We proceeded on the assumption that we could better capture key explanatory variables supporting the complexity of our neurologic patient population at the Ronald Reagan Medical Center of the University of California, Los Angeles (UCLA) by developing a novel electronic health record (EHR) tool that would be integrated into structured templates utilized for all inpatient discharges. Our objective was to improve our overall case mix index (CMI) by more robust documentation that would

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better capture the complexity and associated co-morbidities of our patients.

The aim of this project was to improve case mix index (CMI) by incorporating this novel EHR discharge tool into the discharge documentation of the inpatient general neurology service. The creation of this tool would thereby facilitate improved documentation of the appropriate diagnosis related groups (DRGs) for individual patient cases, better reflecting the complexity or severity of illness, while also improving the efficiency of clinician documentation. With the use of properly structured templates incorporating a novel discharge documentation tool, we hypothesized that this new measure would increase our CMI, improve expected length of stay (LOS), and maximize the coding of major complications and comorbidities (MCCs) over complications and comorbidities (CCs) or DRGs without CC/MCC for the most common neurologic diagnoses.

Methods

Setting

The study was conducted at the Ronald Reagan UCLA Medical Center (RR UCLA), one of the medical centers within the UCLA Health System. It is a 520-bed hospital and a tertiary academic medical center located in a large, metropolitan urban area on the west side of Los Angeles. It is a comprehensive stroke center, level I trauma center, and level 4 epilepsy center.

The intervention was applied to discharge documentation of the general neurology inpatient service, which is an academic service with rotating medical students, residents, and attending faculty. The general neurology inpatient service at the Ronald Reagan UCLA Medical Center includes both a consult and primary team, thus team members both admit and discharge patients from the service, as well as handle consults from other teams pertaining to patients with neurologic issues. The inpatient general neurology team can admit and discharge patients on any day. The general neurology inpatient team cares for a range of neurologic patients on their service including those admitted for seizures, demyelinating disease, or neuromuscular disorders. Vascular neurology patients are managed by a separate vascular neurology/stroke team, which is also both a consult and primary team. Neurology residents rotating on the service write the discharge summaries for all patients who are discharged from the service.

Intervention Development

A team composed of neurology housestaff, a neurology nurse practitioner, data analysts, neuro-informaticists including those on the clinical documentation improvement (CDI) team, and quality improvement leadership was formed. The team began by exploring the Vizient AMC Hospital: Risk Model Summary for Clinical Data Base (CBD) 2017 and reviewed the top ten neurology diagnoses reviewed by U.S. News and World Report. We obtained the Medicare Severity-Diagnosis Related Group (MS-DRG) major complications and comorbidities (MCC) for each of the ten diagnoses. We then reviewed the explanatory variables across three categories: direct cost, length of stay (LOS), and mortality, to determine the most common and highest weighted variables across the three models. We extracted the commonly listed explanatory variables for each diagnosis across cost, LOS, and mortality. We then met with the clinical documentation improvement (CDI) team to cross-reference these variables to determine if terminology used was appropriate to minimize hospital queries. These steps are highlighted in the "Plan" section of Figure 1 in the Plan-Do-Study-Act (PDSA) cycle.

The subsequent stage of development involved collaborating with the medical informatics team to build a discharge documentation tool. This tool was a "Smart List" for discharge diagnoses in the Epic CareConnect EHR. As shown in Figure 2, when a healthcare provider selects a relevant diagnosis from the Smart list, each of the 10 diagnoses then lists a subsequent drop-down menu prompting the provider to click on the relevant explanatory variables, or associated clinical diagnoses, for the patient. For example, as seen in Figure 2, if someone were to select "Demyelinating Disorders of the CNS," a drop-down menu would then appear with associated diagnoses such as Multiple Sclerosis and Neuromyelitis Optica, but also other diagnoses that neurology residents might forget to include such as malnutrition or anemia. Were the resident to select "malnutrition", a further drop-down would prompt them to specify whether it was calorie malnutrition, protein malnutrition, or protein-calorie malnutrition, as well as its severity: mild, moderate or severe. Overall, we piloted the drop-down menus three times, the first done by the neurology nurse practitioner to ensure accuracy. We then asked the residents on the inpatient general neurology service to pilot this discharge documentation tool for an initial 3-month period during the fall and winter of 2018, and on the third iteration of the tool, for a second 3-month period in the spring of 2019.

The neurology residents provided feedback on the tool to enhance its usability. Examples of revisions included wording improvements beneficial for clinicians, such as replacement of "Brain Disorder" with "Structural Brain Damage." Overall, the tool was well-received for its convenience and its ability to prompt residents to include diagnoses they might have omitted in discharge documentation. The CDI team continued to provide feedback on language to reduce hospital queries.

Our data analysts applied these revisions to the subsequent iteration of the documentation tool. Upon the conclusion of the pilot, our team collaborated with the Neurology Chief Residents to incorporate the tool into a standardized discharge note template to be disseminated for use by all neurology residents during the 2019-2020 academic year. Subsequently,
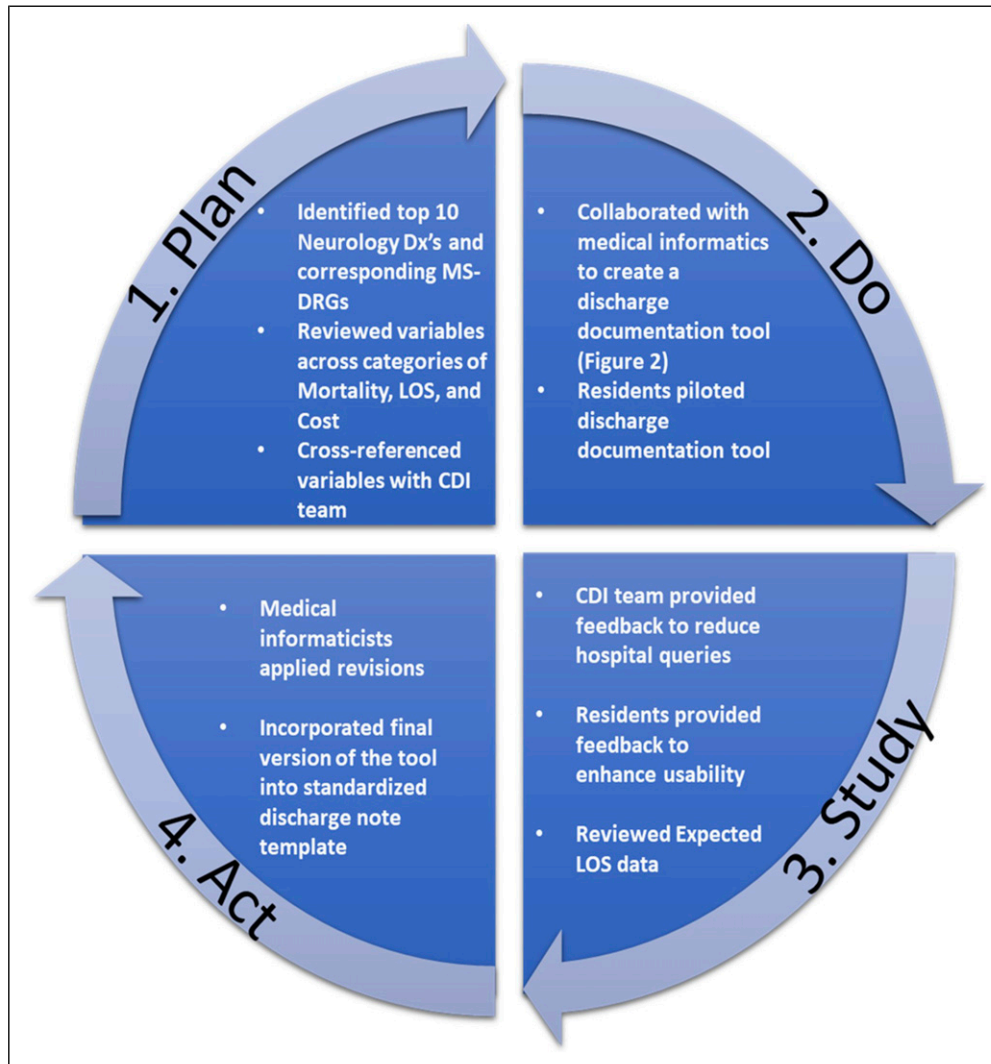
Figure 1. The Plan-Do-Study-Act (PDSA) cycle that was implemented to create the initial iteration of the electronic health record (EHR) discharge diagnosis documentation tool.

neurology residents have used the updated discharge note template for discharge documentation.

Study Design and Data Analysis

The intervention period was the 24-month from July 2019 to June 2021. This period was compared to a 24-month period from July 2017 to June 2019, which did not overlap with any other quality improvement initiatives in the department of neurology. In addition, given necessity of time to encourage adoption of this EHR tool among all neurology residents as well as the possible influences of the COVID-19 pandemic, we also analyzed pre- and post-intervention periods ranging from June 2018-June 2019, and January 2021-January 2022. Outcome measures included mean expected LOS, mean CMI, and percentage of encounters classified as with Major Complications/Comorbidities (MCC), with Complication/Comorbidity (CC), and without CC/MCC. We

used Vizient service line data as part of our analysis. Vizient is a patient safety and healthcare performance improvement company that provides risk-adjusted benchmarks for approximately 200 academic medical centers in the United States. Data were collected from administrative databases and the electronic medical record.

Per the UCLA Institutional Review Board (IRB), clinical QI activities defined as systematic, data-guided activities designed to implement promising ways to improve clinical care, patient safety and health care operations do not require IRB review.

Mean expected length of stay and mean case mix index were calculated and then compared between the pre- and post-intervention period using two sample t-tests. The percentage of encounters classified as with Major Complications/Comorbidities (MCC), with Complication/Comorbidity (CC), and without CC/MCC were compared using tests of proportions to test if the difference in proportion was significant between each time period. Statistical analyses

Figure 2. Example of dropdown choices in the EHR template. This example demonstrates how the dropdown list in the EHR were to appear if a neurology resident selected "Demyelinating Disorders of the CNS". The dropdown list would include other associated clinical diagnoses, prompting trainees to also include diagnoses such as "malnutrition" and "anemia" if they were present, and then also specify the type of malnutrition and severity.

were performed using the base R statistical software (R v. 3.6.3, 2020).[10] Two-tailed statistical significance was assessed at the $P < .05$ level.

Results

The comparison of average CMI in the two pre- and post-intervention periods can be found in Figure 3. In the 2-year analysis, there was a statistically significant increase from pre- to post-intervention in mean CMI from $1.23 \pm .10$ during July 2017-June 2019, $1.36 \pm .19$ during July 2019-June 2021 ($P < .01$). In the 1-year analysis, there was a statistically significant increase from $1.22 \pm .99$ during June 2018-June 2019, to $1.42 \pm .20$ during January 2021-January 2022 ($P < .01$). Mean expected length of stay did not change significantly in either interval comparison.
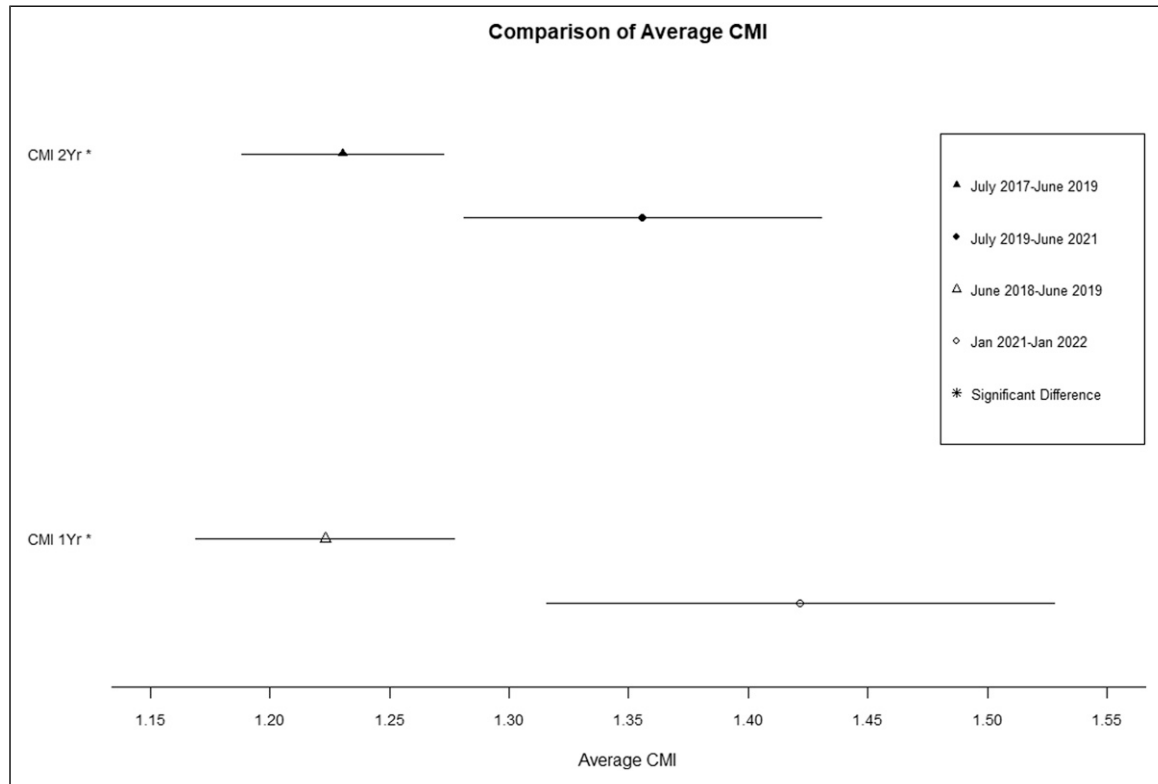
Figure 3. Average CMI compared between the July 2017 to June 2019 pre-intervention and July 2019 to June 2021 post-intervention time period (CMI 2Yr). Average CMI compared between the June 2018 to June 2019 pre-intervention and January 2021-January 2022 post-intervention time periods (CMI 1Yr). *Significant difference (P < .01).

In the 2-year analysis, the MCC percentage for the "Bacterial infections" DRG statistically significantly increased (26.1%, 58.6%, $P < .05$). The MCC percentage for "Non-bacterial infections" DRG statistically significantly decreased (57.3%, 34.6%, $P < .05$). Although not statistically significant, in the 2-year analysis, the MCC percentages for the "Other Disorders of Nervous System", "Multiple Sclerosis" and "Nervous System Neoplasms" DRGs show a pattern of increased post-intervention percentage, while the without CC/MCC percentages decreased for "Bacterial infections," "Other Disorders of Nervous System," and "Multiple Sclerosis." In the 1-year analysis, the MCC percentages for "Bacterial infections", "Other Disorders of Nervous System," "Multiple Sclerosis," "Degenerative Nervous System Disorders," and "Nervous System Neoplasms" showed a non-significant increase post-intervention, while the "without CC/MCC" percentages showed a non-significant decrease for "Bacterial infections," "Other Disorders of Nervous System," and "Multiple Sclerosis" (Figure 4).

Discussion

We found that CMI improved after implementation of our EHR discharge diagnosis documentation tool, supporting our hypothesis that improved discharge diagnosis documentation would better capture the secondary comorbidities of patients admitted to the inpatient general neurology service. In addition, while not statistically significant, for a majority of DRGs, there was a pattern of greater proportion of DRGs with MCCs and fewer DRGs without CC/MCC. By improving documentation of the complexity of patients admitted to the inpatient general neurology service, there may be improved reimbursement and revenue gains to the hospital, which has been demonstrated in other studies that have demonstrated improved CMI.[11] The strengths of this project include its novel approach to improving CMI by addressing discharge documentation through the incorporation of a new EHR tool into neurology resident workflow.

While we are unable to directly attribute the improvement in CMI to the implementation of our intervention, there were no other ongoing quality improvement interventions that would influence CMI during this period. We thus demonstrate in this study that the implementation of this innovative documentation tool has potential to improve metrics such as CMI. Our review of the literature reveals a paucity of studies that have investigated a similar approach. Other groups have used related approaches to address improved discharge documentation by implementing a single step documentation query system, which improved departmental CMI and
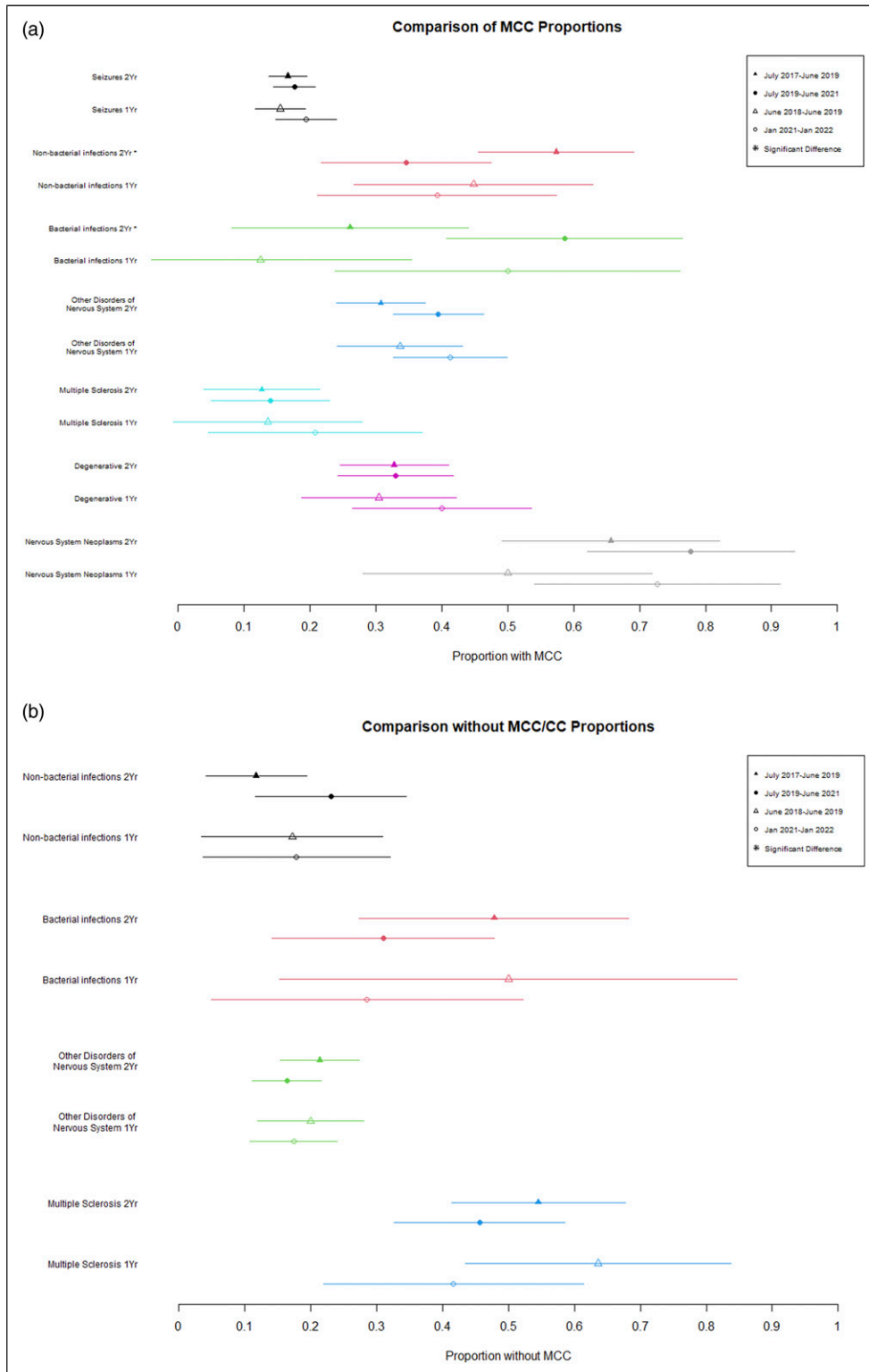
Figure 4. (A) MCC percentages for the analyzed DRGs compared between the July 2017 to June 2019 pre-intervention and July 2019 to June 2021 post-intervention time period (2 Yr) and MCC percentages for the analyzed DRGs compared between the June 2018-June 2019 pre-intervention and January 2021-January 2022 post-intervention time period (1 Yr). (B) Without MCC/CC percentages for the analyzed DRGs compared between the July 2017 to June 2019 pre-intervention and July 2019 to June 2021 post-intervention time period (2 Yr) and Without MCC/CC percentages for the analyzed DRGs compared between the June 2018-June 2019 pre-intervention and January 2021-January 2022 post-intervention time period (1 Yr).

decreased observed/expected mortality ratios.[12] Others have similarly demonstrated that improvements in documentation yielded revenue gains for an inpatient service at a public hospital after creating a concentrated Coding and Documentation Program.[11] While other studies have similarly instituted new discharge summary tools, such as an updated discharge summary template, their studied outcomes focused on timeliness of discharge summary completion and outpatient provider satisfaction.[13]

There exist several studies that focus on a variety of educational curricular innovations to improve discharge documentation, including non-monetary incentive programs,[5] direct feedback mechanisms,[4] workload reduction,[14] and structured workshops.[15] This intervention did require education of neurology residents to increase awareness of the use of the new discharge documentation tool in an updated discharge summary note template, as well as interval reminders to use the updated note template. However, it differs from the abovementioned approaches and other previously described curricular innovations centered around teaching trainees the essentials of discharge summary preparation or use of discharge summary scorecards.[8,16]

The expected length of stay in our study did not improve, which was in opposition to our original hypothesis. We suspect this was because the models used already accounted for the variables documented with the discharge diagnosis template and the template did not include variables specific to expected LOS, as we had assessed the most common and highest weighted variables across the three domains of cost, LOS and mortality. The CDI team likely did not contribute to this finding as they do not query for strictly LOS variables.

There are several limitations of this study, one of which is generalizability. This study was conducted in an inpatient general neurology service, and so the findings of this study may not be applicable to other specialties. Neurology is primarily a diagnostic specialty whose patients may have multiple medical comorbidities. This study was conducted at an academic medical center, so findings may not be entirely generalizable to other subspecialties or practice settings. However, the utility of this discharge documentation tool could easily be leveraged by specialties that have a limited number of common discharge diagnoses, such as surgical subspecialties, and may be a better fit for these subspecialties than those that have a broader range of possible discharge diagnoses, such as internal medicine. There are current plans to create a similar discharge documentation tool for the epilepsy monitoring unit at UCLA, as that inpatient service has a limited number of discharge diagnoses, and thus the implementation of a similar tool would lend well to capturing discharge diagnoses in this patient population.

Another influencing factor that limits the interpretation of the outcomes is the occurrence of the COVID-19 pandemic. The COVID-19 pandemic occurred from early 2020 onwards, impacting inpatient hospital volumes in multiple disciplines, including inpatient neurology. Neurology was one of the specialties that experienced the greatest reduction of hospital discharges (-42.9%) in April 2020, and even by July 2020, continued to lag behind at -9.8%.[17] We anticipate that these reductions in hospital discharge volumes may have affected our analyzed measures. However, we attempted to address this by conducting an additional 1-year analysis comparing June 2018-June 2019 and January 2021-January 2022 to avoid influences on patient volumes at the height of the pandemic.

The COVID-19 pandemic may have also influenced the finding pertaining to the "non-bacterial infection" DRG. We found that there was a statistically significant decrease in the percentage with MCC for the "non-bacterial infection" DRG, while the percentage without MCC/CC for the "non-bacterial infection" DRG increased in the 2-year analysis, which was contrary to our hypothesis. One possible explanation for this finding is that, during the height of the COVID-19 pandemic, there was a period of a few months during which overflow COVID-19 cases were admitted to the general neurology service in order to support internal medicine and intensive care unit (ICU) services that were at maximum capacity, even if they did not have a primary neurologic diagnosis. These cases would have been considered "non-bacterial" and may have influenced our metrics, since less complex, more medically straightforward COVID-19 cases would have been triaged to admission onto the general neurology service, while more complex cases likely would have been admitted to internal medicine and ICU services. However, when we conducted the 1-year analysis, these findings were attenuated, thus supporting our approach for conducting the additional 1-year analysis.

This EHR tool is still relatively early in its implementation, and so future work should be pursued to continue monitoring these metrics over a longer period of time. Future iterations of this EHR tool could also incorporate auto-population of discharge diagnoses using pre-existing problem lists to minimize drop-down menu fatigue. Future directions also include expanding this tool to other service lines, such as neurosurgery, urology or cardiology, or to other institutions. In addition, studying other outcomes such as impact on financial revenue or neurology resident satisfaction and efficiency in completing discharge documentation would be of interest as an educational intervention.

Acknowledgments

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