Interventions to minimize complications in hospitalized patients with Parkinson disease

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Neurology: Clinical Practice February 2020 vol. 10 no. 1 23-28 doi:10.1212/CPJ.0000000000000709

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Abstract

Background

In this study, we sought to evaluate the efficacy of inpatient interventions on hospitalization-related complications in patients with Parkinson disease (PD). Hospitalized patients with PD have an increased risk of complications. Although several interventions have been suggested in the literature, data-driven recommendations are limited.

Methods

This study was designed as a prospective cohort study. A hospital-wide alert system was incorporated into the electronic medical record (EMR) system. The alert was triggered when a patient with PD or on dopaminergic therapy was admitted prompting the inpatient pharmacy to confirm medication details. A warning was also triggered if antidopaminergic medications were ordered. In-services were performed for nursing staff and physicians regarding these measures. Charts of patients with PD admitted 6 months before and after the intervention were reviewed to serve as the 2 comparison groups.

Results

There were 73 patients (mean 73.2 years) preintervention group and 103 patients (mean 72.3 years) postintervention group. There were no significant differences in reasons for admission, admission to neurologic vs non-neurologic floor, or admitting service between the groups. The percentage of patients for whom contraindicated medications were ordered decreased from 42.5% to 17.5% ($p < 0.001$). Medication administration with doses given over 30 minutes late decreased from 46% to 39% ($p = 0.068$). Medications ordered correctly were 42.9% vs 54.7% ($p = 0.131$) before and after the intervention. Length of stay was 5.3 vs 5.2 days ($p = 0.896$), and mean complications were 0.38 vs 0.37 ($p = 0.864$).

Conclusion

An intervention involving EMR alerts and in-service didactics for nurses and physicians decreased the frequency of contraindicated medications ordered in hospitalized patients with PD, but it did not change other hospital outcomes or complications.

It has been well established that patients with Parkinson disease (PD) are at a higher risk of hospitalization compared with age-matched controls.¹ In a National Parkinson's Foundation Centers of Excellence evaluation, nearly half the patients assessed at a baseline visit were shown to have a hospital encounter during a 2-year follow-up, with this recurrent hospitalization being significantly higher in those who had experienced a previous hospitalization.²

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Funding information and disclosures are provided at the end of the article. Full disclosure form information provided by the authors is available with the full text of this article at Neurology.org/cp.

Furthermore, it has been demonstrated that this patient population is at a higher risk of complications once they are admitted.^{3,4} Specifically, there is a higher risk of falls, aspiration pneumonia, and motor decline.^{5,6} Several reviews have established the increased incidence of receiving antidopaminergic medication when admitted to the hospital^{5,7} and subsequently the increased number of complications in patients who do receive antidopaminergic medications.^{8,9} Medication mismanagement is another frequently identified variable in hospitalized patients with PD.^{7,9} Besides the detriment in health from hospital complications on the patient, there is also the factor of medical cost to disease. Huse et al.¹⁰ quantified the medical care costs for individual patients with PD and projected total national costs of PD, indicating that nearly 20% of the annual projected cost of \$23 billion for all patients with PD in the United States is related to inpatient care.

There are several suggestions in the literature in regard to minimizing the identified risks of complications in hospitalized patients with PD.^{4,11,12} However, the efficacy of these suggested measures has not been well evaluated or documented. To minimize risks for this patient population, we implemented an electronic medical record (EMR) alert system and conducted in-service training regarding the known and modifiable risk factors. We analyzed complications and incidence of antidopaminergic therapies before and after implementing these measures.

Methods

In November 2015, Dignity Health implemented measures to reduce and limit common errors in patients with PD as identified in the literature.¹³ Specifically, ordering and administering of contraindicated medications (primarily antidopaminergic medications), mismanagement of home medications, lack of aspiration precautions, and increased fall risk were considered. In collaboration with the hospital system's IT department, alerts in the EMR system, Cerner PowerChart, were prompted when a patient with a diagnosis of PD (based on documented *International Classification of Diseases* codes) and/or on PD medication arrived at the hospital. Multiple in-service trainings were conducted in St. Joseph's Hospital and Medical Center with nursing staff and physicians regarding the importance of these measures. The training service was optional for nursing staff and was conducted as a 3-hour session with an experienced Movement Disorders nurse. In addition, a senior movement disorder clinician outlined the intervention and rationale in the setting of a Neuroscience Grand Rounds and resident/student lectures.

A data request was made during the 6 months preceding and 6 months following quality control measures' implementations. Charts of all patients with a diagnosis of "Parkinson disease" and "parkinsonism" and/or on dopaminergic medication on admission were reviewed individually to extract the needed information. Each admission was reviewed and

Patients who had contraindicated medication orders decreased from 42.5% to 17.5% ($p=0.001$) before and after the interventions.

considered an individual encounter, even if it was for the same patient. Data were stored in a spreadsheet and then analyzed.

Standard protocol approvals, registrations, and patient consents

This study was conducted with local institutional review board (IRB) approval before implementing interventions and reviewing patients' charts. Waiver for consent was approved by the IRB. Data were collected, stored, and analyzed with IRB approval and included measures to protect PHI.

The primary outcomes examined were length of stay (LOS), in-hospital complications (i.e., falls, delirium, infection, need for feeding tube, or institution of palliative care measures), and discharge to a higher level of care than at admission, and medication administration. Medication administration included 3 elements: percentage of patients for whom contraindicated medication was ordered; ratio of home parkinsonian medication doses that were given within 30 minutes of typical administration time relative to total doses given during the hospital stay; and frequency that medications were ordered based on home schedule.

Information gathered also included basic demographics (age, sex, duration of PD diagnosis (if known), and number of comorbidities identified by coexisting diagnoses recorded (measured as Charlson Comorbidity Index [CCI]¹⁴), outpatient PD medications calculated as levodopa equivalent dosing (LED),¹⁵ reason for admission, and admitting service. If known, it was noted whether the patient was followed by a Movement Disorders specialist as an outpatient. The admitting service was characterized as medicine (internal medicine/family medicine), neurosurgery, neurology, or other (obstetrics, trauma, urology, and general surgery). If admitting service was not neurology, it was noted whether neurology was consulted during that admission. On admission, it was noted whether the orders placed replicated home dosing schedules. Number of times medication was missed, reason for missed doses, and number of doses given correctly defined as administration within 30 minutes of scheduled time were reviewed. Patient dispositions were noted—home, skilled nursing facility, inpatient rehabilitation center, and morgue. This was compared to where patients were admitted from e.g., home vs skilled nursing facility, and it was noted whether they were discharged to a higher level of care.

Exclusion criteria included patients admitted for DBS placement or lead replacement and patients only seen in the emergency department without admission.

Statistical analyses used were independent samples *t* test for continuous variables and Pearson χ^2 for continuous variables. For each variable, participants with missing data were excluded from the given analysis. There were missing data primarily for disease duration (n with data = 132) and specialty of outpatient provider managing their disease (n with data = 157).

Data availability

Anonymized data will be shared by request from any qualified investigator.

Results

In the preintervention group, 83 encounters were reviewed. Of these, 5 encounters were excluded because of incorrect or unconfirmed diagnosis (suggested PD on a previous admission but subsequent change in diagnosis before admission and first mention of possible PD at the reviewed encounter for unrelated issues). Five encounters were excluded as these patients were on a dopamine agonist for an alternative diagnosis (e.g., restless leg syndrome). A total of 73 encounters were included in the final analysis of the preintervention group. In the postintervention group, 111 encounters were reviewed. Of these, 5 encounters related to a single patient with a complicated course primarily related to advanced glioblastoma multiforme were excluded. Three encounters were excluded because of incorrect diagnosis code usage. A total of 103 encounters were included in the postintervention group for final analysis.

There were no differences between the preintervention and postintervention group in regard to age, duration of diagnosis, LED, CCI, or reason for admission (table 1). In addition, the admitting services in the 2 groups were not significantly different. Both groups were more likely to be male.

LOS, number of complications, and discharge to a higher level of care were not different between the 2 groups. LOS was 5.3 ± 4.7 days and 5.2 ± 4.9 days before and after the interventions, respectively ($p = 0.896$). It was noted that the LOS before and after the intervention was 5.9 ± 4.5 to 4.1 ± 3.4 days ($p = 0.054$) on non-neurologic floors vs 4.9 ± 4.8 to 6.2 ± 5.8 ($p = 0.247$) on neurologic floors. Number of complications was similar at 0.38 ± 0.7 and 0.37 ± 0.6 ($p = 0.867$). Discharge to a higher level of care relative to before admission was noted in 35.6% of the patients in the preintervention group compared with 35.0% in the postintervention group ($p = 0.927$).

Patients who had contraindicated medication orders decreased from 42.5% to 17.5% ($p = 0.001$) before and

The primary outcomes in this study were length of stay (LOS), number of complications, and discharge to a higher level of care.

after the interventions (table 2). This difference preintervention and postintervention was observed on neurologic floors (36.4%–14.5%, $p = 0.012$) and non-neurologic floors (51.7%–20.8%, $p = 0.005$). Percentage of medication doses given within 15 minutes increased from 27% to 30% ($p = 0.327$), and percentage of medication doses given within 15–30 minutes of scheduled time increased from 19% to 23% ($p = 0.081$). Doses given after 30 minutes of scheduled time decreased from 46% to 39% but was not significant. Number of missed doses did not change as an effect of the interventions ($p = 0.632$). Medications ordered by home schedule increased from 42.9% to 54.7% ($p = 0.131$).

Table 1 Patients' information and admission variables

	Preintervention (n = 73)	Postintervention (n = 103)	<i>p</i> Value
Age (y)	73.15 $\pm$ 9.58	72.26 $\pm$ 12.06	0.601
Disease duration (y)	7.24 $\pm$ 9.16	6.96 $\pm$ 6.43	0.837
LED (mg)	649.73 $\pm$ 495.15	653.95 $\pm$ 481.75	0.955
CCI	4.55 $\pm$ 1.78	4.53 $\pm$ 2.42	0.967
Sex, male	50 (68.5%)	69 (67.0%)	0.834
Reason for admission			0.269
Infection/sepsis	10 (13.7%)	25 (24.8%)	
Surgery	23 (3.5%)	26 (25.7%)	
Encephalopathy	7 (9.6%)	5 (5.0%)	
Stroke	6 (8.2%)	5 (5.0%)	
Other	27 (37.0%)	40 (39.6%)	
Admitting service			0.300
Neurology	16 (21.9%)	20 (19.4%)	
Medicine/critical care	31 (42.5%)	50 (48.5%)	
Neurosurgery	23 (31.5%)	23 (22.3%)	
Other	3 (4.1%)	10 (9.7%)	
Admitted to neurologic floor	29 (39.7%)	48 (46.6%)	0.365
Neurology consulted	33 (45.2%)	42 (40.8%)	0.558

Abbreviations: CCI = Charlson Comorbidity Index; LED = levodopa equivalent dosing.

Table 2 Outcomes 6 months before and after inpatient interventions to minimize complications in hospitalized patients with PD

	Entire sample (n = 176)	Preintervention (n = 73)	Postintervention (n = 103)	p Value
LOS (d)	5.25 ± 4.82	5.30 ± 4.68	5.21 ± 4.94	0.896
Contraindicated medications ordered (n)	49 (27.8%)	31 (42.5%)	18 (17.5%)	<0.001
No. of complications	0.37 ± 0.67	0.38 ± 0.72	0.37 ± 0.63	0.867
Complications 1+	53 (30.5%)	22 (30.1%)	31 (30.7%)	0.937
Medication given within 15 minutes (%)	29 ± 19	27 ± 15	30 ± 21	0.372
Medication given in 15–30 minutes (%)	22 ± 0.15	19 ± 0.13	23 ± 0.16	0.081
Medication given >30 minutes late (%)	42 ± 0.21	46 ± 0.19	39 ± 0.23	0.068
Missed medications (%)	8 ± 0.15	8 ± 0.15	8 ± 0.16	0.983
Discharge to a higher level of care (n)	62 (35.2%)	26 (35.6%)	36 (35.0%)	0.927
Medications ordered per home schedule (n)	82 (49.7%)	30 (42.9%)	52 (54.7%)	0.131
Neurology service consulted (n)	75 (42.6%)	33 (45.2%)	42 (40.8%)	0.558

Abbreviations: LOS = length of stay; PD = Parkinson disease.

In post hoc analyses of all patients, there was an overall main effect of admitting service on LOS ($p = 0.012$). Patients admitted to “other” services, i.e., general surgery, trauma, urology, and obstetrics/gynecology, had an LOS of 9.4 ± 9.7 days. Patients on neurology service, neurosurgery service, and medicine services were admitted for 4.6 ± 4.5 , 4.7 ± 3.8 , and 5.1 ± 4.1 days, respectively. Predictably, patients with longer lengths of stay had a longer disease duration ($r = 0.189$, $p = 0.046$), were more likely to have had 1 or more inpatient complications ($r = 0.500$, $p < 0.001$), and had a higher CCI score ($r = 0.239$, $p = 0.003$).

Patients managed by a Movement Disorders specialist in the outpatient setting had fewer inpatient complications relative to patients who did not see a subspecialist ($p = 0.022$). In regard to complications, there was a positive correlation found with age ($r = 0.217$, $p = 0.007$), CCI ($r = 0.315$, $p < 0.001$), and percentage of missed doses ($r = 0.227$, $p = 0.008$). Predictably, these patients with 1 or more complications were also more likely to be discharged to a higher level of care ($p < 0.001$).

Discussion

In an effort to minimize complications in hospitalized patients with PD, we designed an intervention consisting of EMR alerts and in-service didactic training sessions for nurses and physicians. We found that this intervention significantly reduced the prescribing of contraindicated medications, but it did not change other hospital outcomes or complications, such as falls, delirium, infections, and LOS. It has been well established in the literature that patients with PD are admitted to the hospital more often than individuals without PD.¹⁶ It is also known that once admitted to the hospital,

these patients are more likely to have prolonged hospital stays, are at an increased risk of medication errors, have poorer motor outcomes, and are at a higher risk of readmission.⁴ Several interventions have been evaluated to minimize the risk of admissions to hospitals in patients with PD.^{17–20} However, there is a dearth of evaluated interventions to minimize risks once these patients are admitted to the hospital.¹⁷ Specialists in the field have developed informal recommendations for the management of hospitalized patients with PD based on observed correlations, but there is a lack of published evidence-based interventions. A survey of 43 National Parkinson Foundation Centers of Excellence resulted in suggested targets for improvement of patients with PD.²¹ These suggestions included improvement in communication among staff once patients with PD are admitted and developing educational programs directed to hospital staff and physicians regarding PD. Medication mismanagement is also another factor that has been repeatedly identified as a risk factor for poor outcomes in retrospective analyses of hospitalized patients with PD.^{5,13} Our study is one of the few reported in the literature, which objectively assesses the effect of some of the recommended interventions on outcomes in hospitalized patients with PD. In our study, we analyzed the effect of education and an EMR alert system on inpatient management of patients with PD. We found that these interventions decreased the frequency of contraindicated medication orders in patients with PD in addition to indicating improvement in the timeliness of medication administration, both of which have been previously linked with worse outcomes.^{8,9}

The primary outcomes in this study were LOS, number of complications, and discharge to a higher level of care.

Although the interventions implemented in the study had a clear effect on factors that have been previously shown to influence the primary outcomes mentioned, they did not have the expected improvement in our analysis. The reasons for this may be several fold: (1) LOS was determined by the admit and discharge dates noted in the EMR; we did not account for patients who may have been ready for discharge but had a prolonged stay due to placement issues, e.g., obtaining insurance authorization of inpatient rehabilitation transfers in a timely manner or logistics of transferring to a skilled nursing facility of the patient's preference. Although these are issues that unnecessarily prolong hospital stays and are associated with their own set of concerns that should be addressed, they can confound the true benefit of interventions on LOS needed for a given admission. (2) Complications were determined by individual chart review and as such at risk of human error. In the current EMR in our hospital, automatic alerts are triggered for specific complications tracked by the entire hospital system such as falls or catheter-associated urinary tract infections. For the patient population reviewed, additional factors were considered in assessing complications, which included in-hospital delirium and aspiration pneumonia. The occurrence of these events was determined by reviewing nursing and physician notes and, if not specifically documented, may have been missed in the assessment. (3) The educational aspect of the intervention was optional and noted to be attended by physicians and staff primarily on the neurologic floors of the hospital. The training for nursing staff was presented as a single 3-hour session attended by nurse educators and then subsequently disseminated to nurses on the floors by each of the attendees. The presentation of the training inadvertently targeted staff familiar with neurologic disease and excluded non-neurologic specialties. It has been shown that the majority of hospital admissions in patients with PD are not related primarily to their PD.²² As such, it is important for educational events to actively reach out to all specialties. Furthermore, our hospital system has a dedicated neuroscience building with full-time neurologists and neurology residents taking care of patients. We suspect that the interventions assessed in our study are likely to be more impactful in centers where there is limited access to neurology or who may be more unfamiliar with the complications associated with PD. In addition, we would suggest shorter educational sessions implemented more frequently or as part of a recorded module that could be distributed to a larger audience in the future. Last, it is possible that independent factors related to disease severity are driving the apparent associations previously seen between medication issues in the hospital and poorer hospital outcomes.

Incidentally, it was noted that patients who were seen by a Movement Disorders specialist in the outpatient setting had fewer complications compared with patients who were not. This finding is in keeping with previous observations published in the literature.^{21,23} Given that patients with more comorbidities and older age were also found to have a higher

incidence of complications, it may be beneficial to promote Movement Disorder referrals in this higher-risk cohort.

In conclusion, targeting risk factors that have been correlated with poorer outcomes in patients with PD, we implemented an EMR alert system and educational sessions for hospital staff, which decreased the rate of contraindicated medication orders and seemed to improve the timeliness of medication administration. Although these changes did not influence the primary outcomes in our evaluation, it is one of the few assessments of hospital-based interventions in this patient population and warrants further investigation in various hospital systems to better evaluate the effect on a larger scale.

Study funding

This study was sponsored by institutional funding through the Barrow Neurological Foundation.

Disclosure

S. Aslam, E. Simpson, and M. Baugh report no disclosures. H. Shill has received research support from Biogen, Dong-A ST Co., Ltd., MagQu. Intec Pharma, Ltd, US WorldMeds, and Sunovion/Cynapsus Therapeutics, Inc. and has received consulting honoraria for AbbVie and Sunovion advisory boards. Full disclosure form information provided by the authors is available with the full text of this article at Neurology.org/cp.

Publication history

Received by *Neurology: Clinical Practice* March 25, 2019. Accepted in final form May 30, 2019.

Appendix Authors

Name	Location	Contribution
Sana Aslam, DO	Barrow Neurological Institute	Designed and conceptualized the study; interpreted the data; analyzed the data; and drafted the manuscript for intellectual content
Edith Simpson, RN	Barrow Neurological Institute	Designed and conceptualized the study and major role in the acquisition of data
Matthew Baugh	Barrow Neurological Institute	Designed and conceptualized the study and major role in the acquisition of data
Holly Shill, MD	Barrow Neurological Institute	Designed and conceptualized the study; interpreted the data; and revised the manuscript for intellectual content

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doi:10.1212/CPJ.0000000000000709

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