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Correlation between medication administration-related errors in patients with parkinson disease and timing of pharmacy-led best possible medication histories

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Correlation between Medication Administration–Related Errors in Patients with Parkinson Disease and Timing of Pharmacy-Led Best Possible Medication Histories

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ABSTRACT

Background: Poor prescribing and incomplete medication administration have been linked to increased lengths of hospitalization for patients with Parkinson disease. The Institute for Safe Medication Practices (ISMP) has recommended that patients with Parkinson disease receive a pharmacy consultation within 2 h of admission to hospital.

Objectives: To examine whether the time for a pharmacy team member to obtain a best possible medication history (BPMH) was associated with administration-related medication errors. The primary outcome was the proportion of doses with a medication error during a patient's admission in relation to the time to completion of the initial BPMH by a registered pharmacist (RPh) or registered pharmacy technician (RPhT). The secondary objective was to compare the proportion of doses with a medication error in relation to whether the BPMH was completed by an RPh or an RPhT.

Methods: This retrospective chart review involved patients with Parkinson disease who were admitted to the medicine services at London Health Sciences Centre from September 30, 2014, to September 30, 2018. Patients were included if they had Parkinson disease and a medication regimen that included levodopa-carbidopa. For all patients, an RPhT or RPh conducted the initial BPMH or updated the BPMH. Pearson correlation analysis was used to determine whether a correlation existed between administration-related errors and completion of the BPMH by a pharmacy staff member.

Results: A total of 84 patients with 104 admissions were included. There was no significant correlation between the time to completion of the initial BPMH by a pharmacy team member and the proportion of doses with medication errors ($p = 0.32$). Although RPhTs completed the BPMHs more quickly than RPhs ($p < 0.001$), there was no significant difference between pharmacy team members in terms of the proportion of doses with medication errors ($p = 0.86$).

Conclusions: Completing a BPMH within 2 h of a patient's admission, as per the ISMP recommendation, is unlikely to affect administration-related medication errors, given that no correlation was identified. Expediting BPMH without addressing other factors is insufficient, and initiatives are required to improve the medication administration process.

Keywords: Parkinson disease, best possible medication history, medication error

RÉSUMÉ

Contexte : La mauvaise prescription et l'administration incomplète de médicaments ont été liées à une augmentation de la durée du séjour à l'hôpital des patients atteints de la maladie de Parkinson. L'Institute for Safe Medication Practices (ISMP) a recommandé que les patients atteints de la maladie de Parkinson obtiennent une consultation en pharmacie dans les 2 heures après leur admission à l'hôpital.

Objectifs : Vérifier si le temps d'attente pour l'obtention, par un membre de l'équipe de la pharmacie, du meilleur schéma thérapeutique possible (MSTP) était associé ou non à des erreurs de médication liées à l'administration. Le résultat principal portait sur la proportion des doses comportant une erreur de médication lors de l'admission d'un patient par rapport au temps nécessaire à un pharmacien ou à un technicien en pharmacie autorisés pour réaliser le MSTP initial. L'objectif secondaire visait à comparer la proportion des doses comportant une erreur de médication entre un MSTP réalisé par un pharmacien autorisé et un MSTP réalisé par un technicien en pharmacie autorisé.

Méthodes : Cet examen rétrospectif des dossiers impliquait des patients atteints de la maladie de Parkinson ayant été admis aux services de médecine au London Health Sciences Centre entre le 30 septembre 2014 et le 30 septembre 2018. Les patients pouvaient participer à l'étude s'ils avaient la maladie de Parkinson et qu'ils suivaient un traitement médicamenteux comprenant du lévodopa-carbidopa. Un pharmacien autorisé ou un technicien en pharmacie autorisé réalisait ou actualisait le MSTP initial de tous les patients. La corrélation de Pearson a servi à déterminer s'il existait une corrélation entre les erreurs liées à l'administration et la réalisation du MSTP par un membre du personnel de la pharmacie.

Résultats : Au total, 84 patients correspondant à 104 admissions ont été inclus dans l'étude. Il n'y avait aucune corrélation importante entre le moment de la réalisation du MSTP initial par un membre du personnel de la pharmacie et la proportion des doses comportant des erreurs de médication ($p = 0,32$). Bien que les techniciens en pharmacie autorisés aient terminé plus rapidement leur MSTP que les pharmaciens autorisés ($p < 0,001$), aucune différence importante n'a été notée entre les membres du personnel de la pharmacie en termes de proportion des doses et d'erreur de médication ($p = 0,86$).

Conclusions : Il est peu probable que la réalisation d'un MSTP dans les 2 heures après l'admission d'un patient, conformément à la recommandation de l'ISMP, ait une influence sur les erreurs de médication liées à l'administration, vu qu'aucune corrélation n'a été décelée. Précipiter la réalisation du MSTP sans aborder les autres facteurs ne suffit pas et des actions sont nécessaires pour améliorer le processus d'administration des médicaments.

Mots-clés : maladie de Parkinson, meilleur schéma thérapeutique possible, erreur de médication

INTRODUCTION

Parkinson disease is a progressive neurodegenerative disorder marked by a constellation of clinical manifestations, including bradykinesia, rigidity, a resting tremor, and postural instability.[1] It is thought to be related to the loss of dopaminergic neurons in the substantia nigra. Dopamine replacement therapy is effective and represents the standard of care for these patients.[1]

Over the years, there has been significant interest in the problem of omission of doses of Parkinson disease–related medications during hospitalization. Martinez-Ramirez and others[2] reviewed data for 212 patients with Parkinson disease over 2 years, looking at medication errors related to the wrong time of administration, dose omission, and the use of contraindicated medications. Patients who experienced delayed administration had longer lengths of stay in hospital, and 20% of patients received a contraindicated dopamine blocker. Similarly, Lertxundi and others[3] examined patients with Parkinson disease in the Basque Country and found that medication errors were associated with increased length of stay and a higher mortality rate. Derry and others[4] examined the management of patients with Parkinson disease on surgical wards over an 18-month period. Of the 51 patients receiving medications for this disorder, 71% had missed doses of their medications. Notably, 34% missed more than 10% of prescribed doses. Overall, 12% of all prescribed medication doses for Parkinson disease were missed.[4]

Poor prescribing and incomplete drug administration led to the development of the "ACT on Time" program by Parkinson Canada to improve patients' quality of life and educate health care providers.[5] The program provides patients with educational materials, including a medical alert card, a list of medications to avoid, and a diary to track medications taken and their response, as well as information that the patient should take when visiting the hospital.[5] The goal is to empower patients to advocate for themselves and collaborate with health care providers to ensure that medications are provided at appropriate times. In addition, the Institute for Safe Medication Practices (ISMP) published recommendations for managing the care of patients with Parkinson disease during hospitalization; these recommendations included stocking common Parkinson disease medications to avoid delays associated with use of nonformulary medications, avoiding contraindicated medications, and providing surgery at optimal times (earlier in the day) to avoid delays in medication administration.[6] Notably, one of the recommendations related to expediting pharmacy consultations is to complete the best possible medication history (BPMH) within 2 h of admission.[6] There is currently a lack of literature to support prioritizing patients with Parkinson disease for BPMH, as part of the medication reconciliation process, and to indicate whether the time to completion of BPMH affects patient care.

At the London Health Sciences Centre (LHSC), all members of the health care team are responsible for documenting the BPMH to contribute to an effective medication reconciliation process. Evidence from previous studies of medication reconciliation suggests that registered pharmacists (RPhs) identify significantly more medication discrepancies and consistently document specific doses and schedules to a greater extent than physicians and other health care providers.[7] Further research now supports the utilization of registered pharmacy technicians (RPhTs) to complete BPMHs in various areas of the hospital, as there do not appear to be significant differences between RPhs and RPhTs in terms of medication discrepancies identified.[8] Current evidence supports the RPhT role in the emergency department in reducing potential adverse drug events and identifying medication discrepancies.[8] RPhTs have assisted in the completion of BPMHs in the LHSC emergency department since 2014, with priority for patients who will be admitted to hospital. RPhTs currently exercise professional judgment to determine which patients require an expedited BPMH.

The ISMP recommendation for completion of the BPMH within 2 h of admission[6] is a shift from current standards. The purpose of this study was to establish whether there was any relation between the time to completion of the BPMH by a pharmacy team member and the proportion of doses of medications with errors among patients with Parkinson disease. We also examined the proportion of doses with medication errors during a patient's admission in relation to the particular pharmacy professional who obtained the BPMH.

METHODS

This study was a retrospective review of adult patients with Parkinson disease admitted to LHSC's general medicine services from September 30, 2014, to September 30, 2018. Ethics approval was granted by the Office of Research Ethics and the Western Health Research Institute (HSREB ID 113652).

Patients were eligible for inclusion if they had a diagnosis of Parkinson disease, had a medication regimen that included levodopa-carbidopa, and were admitted to the LHSC general medicine services during the study period. For each qualifying admission, the BPMH had to have been performed or updated by a pharmacy team member, specifically an RPhT or RPh. No additional exclusion criteria were applied.

Patients were identified from a drug usage report of levodopa-carbidopa. The electronic chart of each identified patient was accessed (through the patient's medical record number) and then reviewed by a single author (E.C.) to determine whether the patient met the inclusion criteria. The electronic admission and progress notes were used to identify patients with a diagnosis of Parkinson disease as opposed to those with other indications for levodopa-carbidopa. The medication history "snapshot" was reviewed to determine whether an RPhT or RPh was involved in the BPMH during

the general medicine admission. The admission histories were reviewed to determine whether the patient had additional admissions meeting the inclusion criteria. Appendix 1 (available from: cjhp-online.ca/index.php/cjhp/issue/view/202) provides additional information about the data collected from electronic charts.

Length of stay was calculated as the difference between time of admission and time of discharge, expressed as number of days. The time of admission was collected from the record of the emergency department encounter and represented the time of the decision to admit the patient.

The primary outcome was the proportion of doses with medication errors during a patient's admission in relation to the time taken by a pharmacy team member to complete the initial BPMH. Patients could have multiple updates to the BPMH during their stay. The initial BPMH was defined as the first BPMH completed and documented by a pharmacy team member, and the final BPMH was defined as the last BPMH completed and documented by a pharmacy team member. The proportion of doses with medication errors was defined as the total number of doses of antiparkinsonian medication either omitted or administered more than 60 min before or after the scheduled time, divided by the total number of antiparkinsonian medication doses scheduled. The occurrence of errors in timing of administration was determined by reviewing the electronic medication administration record and evaluating whether any antiparkinsonian medications were administered at the wrong time (i.e., > 60 min before or after the scheduled time) and/or completely omitted. Omissions were defined as a nurse not administering the drug when it was scheduled or a medication being recorded in the BPMH but not ordered.

The secondary outcome was the proportion of doses with medication errors during a patient's admission in relation to which pharmacy team member completed the BPMH. Patients were categorized according to whether an RPhT or RPh completed or modified the BPMH. The medication errors identified during medication reconciliation were evaluated to determine whether they involved antiparkinsonian agents or other medications and whether the medications with discrepancies were included in the BPMH. Additionally, data were collected to identify the most common reasons documented for administration-related medication errors.

Descriptive statistics and frequencies were calculated for continuous and categorical variables, respectively. The continuous variable related to specific errors in timing of administration. The categorical variables included whether patients experienced a medication error and the reasons for the error. Pearson correlation analysis was conducted to examine the relation between the proportion of doses with errors and the time to completion of the BPMH. The Student *t* test was used to examine differences in medication errors and time to BPMH completion between RPhTs and RPhs. Values of p less than 0.05 were considered statistically significant.

RESULTS

A total of 249 electronic patient charts were screened (Figure 1); 165 patients were excluded because they did not have Parkinson disease or a pharmacy team member was not involved in their BPMH during the qualifying admission. Eighty-four patients met the inclusion criteria, of whom 16 patients had at least 1 additional qualifying admission. In total, 104 admissions were included in the data analysis.

Table 1 presents the baseline characteristics for admissions that met the inclusion criteria. The mean age was 80.5 years, with approximately half of the patients being male (54%); for 65% of the admissions, the patient resided at home before admission to hospital. The average number of

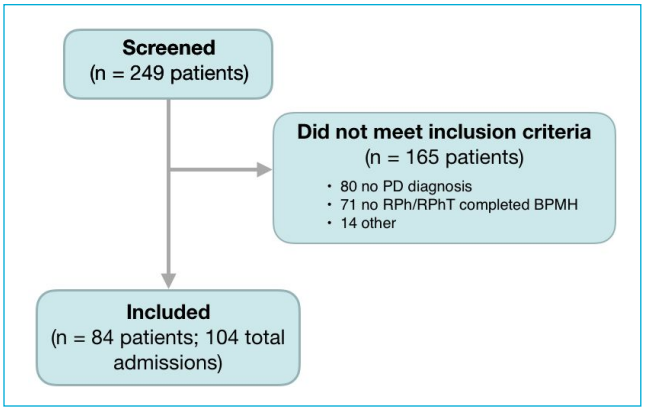

FIGURE 1. Patient flow diagram and exclusion criteria. BPMH = best possible medication history, PD = Parkinson disease, RPh = registered pharmacist, RPhT = registered pharmacy technician.

TABLE 1. Baseline Characteristics

Characteristic	No. (%) of Admissions[a] (n = 104)
Age (years) (mean ± SD)	80.5 ± 10.1
Sex, male	56 (54)
No. of medical comorbidities (mean ± SD)	7 ± 2.5
No. of administrations per day (mean ± SD)	4 ± 2.2
Prior disposition	
Home	68 (65)
Long-term care	31 (30)
Other	5 (5)
Initiation of BPMH	
Medical resident	41 (39)
Registered pharmacy technician	28 (27)
Registered pharmacist	28 (27)
Other	7 (7)
Length of stay (days) (mean ± SD)	5.04 ± 5.9

BPMH = best possible medication history, SD = standard deviation.
[a]Except where indicated otherwise. Data are based on a total of 104 admissions for 84 individual patients.

medical comorbidities was 7. The first BPMH was completed by a medical resident for 39% of the 104 admissions, by an RPh for 27%, by an RPhT for 27%, and by a nurse for 7%. The reason for admission was categorized as infection, weakness or functional decline, altered level of consciousness, cardiovascular-related, or other. The most common reason for admission was infection (37%), followed by weakness or functional decline (31%) (Table 2). The mean length of stay was 5.04 days.

The total number of doses of antiparkinsonian medications scheduled was 2984. Of these scheduled doses, 384 (12.9%) were given at the wrong time. Of the 104 admissions included in the study, 91 (88%) included at least 1 dose that was administered more than 60 min before or after the scheduled time, and 58 (56%) of the admissions had more than 10% of their total doses administered at the wrong time. The most common documented reason for wrong administration time was "clinical judgment", which encompassed 30% of all doses administered at the wrong time (Table 3). Of the 2984 scheduled doses, 260 (8.7%) were omitted altogether. The most common reason for omission of a dose was the medication not being ordered in the emergency department (Table 4). Notably, 23 patients had at least 1 antiparkinsonian medication error identified and addressed by a pharmacy team member. The most commonly documented error involved the frequency of levodopa-carbidopa (e.g., initial BPMH stated twice daily, but RPhT changed to 3 times daily).

The primary outcome—the proportion of doses with a medication error during a patient's admission in relation to the time taken by a pharmacy team member to complete the initial BPMH—was not statistically significant (r = –0.098, p = 0.32; Figure 2). Statistical analysis was also completed according to the time when the final BPMH was completed by a pharmacy team member; no correlation was identified with the proportion of doses having medication errors (r = –0.094, p = 0.34; data not shown).

To address the secondary objective, the time to completion of the initial BPMH was compared between RPhTs and RPhs. RPhTs completed the BPMH significantly more quickly than RPhs: 9.6 versus 35.2 h from the time of admission (p < 0.001; Figure 3). Further analysis of the time to completion of initial BPMH was conducted to examine whether there was a reduction in the proportion of doses with medication errors for patients whose BPMH was completed by an RPhT. Although RPhTs completed the BPMH more quickly, the proportion of doses with medication errors did not differ significantly (p = 0.86; Figure 4).

TABLE 2. Reason for Admission

Reason for Admission	No. (%) of Admissions (n = 104)	
Infection	38	(37)
Weakness/functional decline	32	(31)
Cardiovascular	8	(8)
Altered level of consciousness	7	(7)
Bleeding-related	5	(5)
Other	14	(13)

TABLE 3. Reason for Wrong Time of Dose Administration

Reason for Wrong Administration Time	No. (%) of Instances (n = 384)	
Clinical judgment	114	(30)
Incorrect schedule	90	(23)
Patient unavailable	53	(14)
Medication unavailable	51	(13)
Other	76	(20)

DISCUSSION

Delays in administration of antiparkinsonian medications are a significant concern for patients as they navigate the health care system. It is estimated that 3 of every 4 patients with Parkinson disease will miss doses of their medications

TABLE 4. Reason for Dose Omission

Reason for Omission	No. (%) of Omissions (n = 260)	
Medication not ordered	149	(57)
Medication not appropriate	62	(24)
Medication unavailable	8	(3)
Other	41	(16)

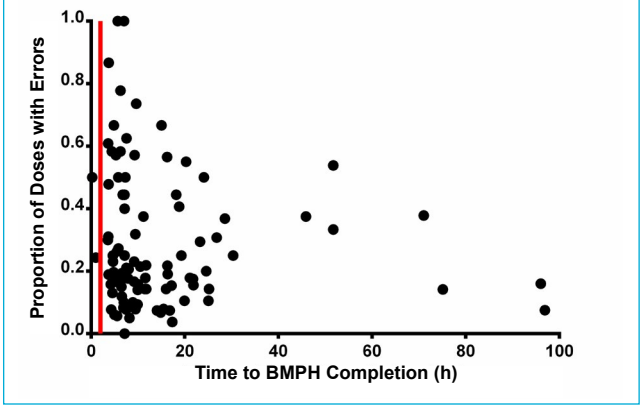

FIGURE 2. Effect of time to complete initial best possible medication history (BPMH) on proportion of doses with a medication error. Each data point represents a single admission. Red line represents the 2-h mark (as recommended by the Institute for Safe Medication Practices[6]). Pearson r = –0.098; p = 0.32.

during a hospital admission.[4] Without timely administration of their medications, patients may experience worsening of their symptoms and a prolonged length of stay.[2-4] ISMP created recommendations for patients with Parkinson disease who are admitted to hospital, including a pharmacy consultation to complete the BPMH within 2 h of admission.[6] To our knowledge, this is the first study examining the roles of RPhs and RPhTs in completing medication reviews with the goal of reducing medication administration–related errors. The aim of the study was to determine whether a relation existed between the proportion of doses with medication administration–related errors and the time to BPMH completion by a pharmacy team member.

We found no significant correlation between the time taken by a pharmacy team member to complete the BPMH and the proportion of doses with medication administration–related errors. On average, RPhTs completed the BPMH 9.6 h after admission, compared with 35.2 h for RPhs. There was no statistically significant difference in the proportion of doses with medication administration–related errors between the 2 groups. No pharmacy team member completed the BPMH within 2 h of admission, although for a total of 5 patients, BPMH was completed by a health care provider outside the pharmacy team within the recommended 2-h time frame. Therefore, no further analysis was performed to determine whether completion of the BPMH within 2 h of admission made a significant difference in outcome.

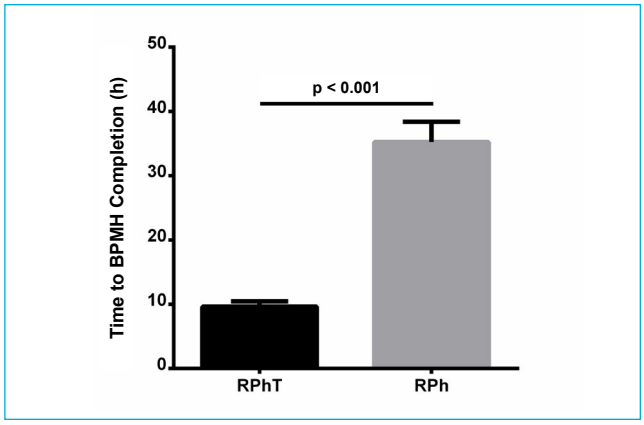

FIGURE 3. Time to completion of best possible medication history (BPMH) by registered pharmacy technicians (RPhT) and registered pharmacists (RPh). Data are shown as means with standard errors of the mean (based on $n = 104$ admissions). The p value was calculated using an unpaired, 2-tailed Student t test.

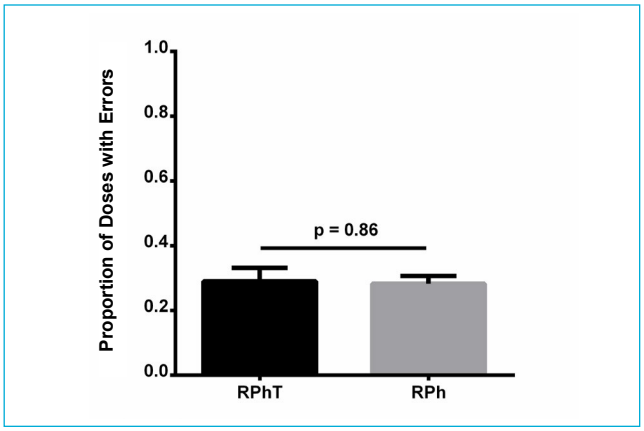

FIGURE 4. Proportion of doses with medication errors for admissions with best possible medication history completed by pharmacy technicians (RPhT) or pharmacists (RPh). Data are shown as means with standard errors of the mean (based on $n = 104$ admissions). The p value was calculated using an unpaired, 2-tailed Student t test.

This study considered 2 different types of medication administration–related errors: errors of timing and complete omission. Timing errors were related to administration of doses more than 60 min from the scheduled time. This timing aligns with previous studies of Parkinson disease and the routine practices of LHSC nurses, whereby they are allowed 60 min before or after the scheduled dosing time to administer any medication. The reasons for wrong timing and dose omissions may indicate factors potentially contributing to the administration-related errors experienced by patients with Parkinson disease. The most commonly documented reason for incorrect timing was clinical judgment (30%), followed by an incorrect schedule (23%). When clinical judgment was reported as the cause of incorrect timing, the administration time ranged from several minutes to hours different from when the dose was due. However, no additional rationale was provided and no further insight was possible, as the electronic charting system does not require nurses to input additional information. Incorrect scheduling of doses reflected provision of medications at the hospital's standardized administration times, rather than according to the patient's individual schedule. The patient's medication schedule was inconsistently documented in the BPMH, and this type of administration error was likely underestimated. Without documentation of the specific home administration schedule and manual modification, the doses are set to be administered according to the hospital's standard administration times. Other reasons for timing errors included patients refusing their medications, nursing staff being busy, and patients being designated to receive nothing by mouth. Further education is required to ensure that health care providers input specific home schedules in the BPMH so that the correct times can be adhered to while the patient is in hospital. It is acknowledged that although staff education may be beneficial, such training would need to be repeated regularly, given the relatively low proportion of patients with Parkinson disease who are admitted to this hospital and the staff turnover rate.

Of the 260 doses that were omitted altogether, 57% were not ordered during the admission process. The proportion of all doses omitted was consistent with previous literature.[2-4] Another source of this type of error was omission of doses before the time of hospital discharge. A large proportion of

patients missed their initial doses in the emergency department, before arriving on the general medicine floor. The data did not capture the number of patients who might have self-administered their medications before presenting to the emergency department. However, to align with the "ACT on Time" initiative, patients with Parkinson disease should be encouraged to bring their medications with them from home, to prevent delay within the initial hours of presentation.[5]

Of the 84 patients included in this study, 23 patients had an antiparkinsonian medication error documented by either an RPh or RPhT. Without the interventions made by the RPhT or RPh, it is hypothesized that a larger number of medication errors would have occurred. These interventions included updating the hospital's records to correctly reflect the patient's home administration times or frequency of administration and the addition of agents that were missed on the initial BPMH. The definition of "medication error" in this study pertained to the timing and omission of doses. This study did not assess medication errors involving different strengths of medications or the number of tablets to be administered. In addition, we did not consider the use of dopamine antagonists, which are contraindicated for patients with Parkinson disease. In other studies,[3,4,9] the use of contraindicated medications was a common type of medication error measured and has been reported to occur in as many as one-quarter of patients. Despite the limitations resulting from the retrospective design of this study, the data demonstrate current challenges in the medication management of patients with Parkinson disease. No clinical outcome data were collected, as such data were not within the scope of the study.

CONCLUSION

Timely administration of medication to hospitalized patients with Parkinson disease remains a challenge. A growing body of evidence has tied delays in administration of antiparkinsonian medication to prolonged length of stay in hospital, mortality, and worsening of the disease. ISMP published several recommendations to reduce medication administration errors in this patient population, including expedited medication reconciliation (within 2 h). In the current study, only 5 patients had BPMH completed within this recommended time frame. Rather than targeting a specific time frame, efforts should be made to ensure that a high-quality review is conducted, to facilitate the medication reconciliation process. Expediting the BPMH without addressing other sources of error is insufficient, and additional initiatives are required to improve the medication-use process.

References

1. Fahn S, Oakes D, Shoulson I, Kieburtz K, Rudolph A, Lang A, et al. Levodopa and the progression of Parkinson's disease. *N Engl J Med.* 2004;351(24):2498-508.
2. Martinez-Ramirez D, Giugni JC, Little CS, Chapman JP, Ahmed B, Monari E, et al. Missing dosages and neuroleptic usage may prolong length of stay in hospitalized Parkinson's disease patients. *PLoS One.* 2015;10(4):e0124356.
3. Lertxundi U, Arantxa I, Solínis MA, Domingo-Echaburu S, Hernandez R, Peral-Aguirregolita, et al. Medication errors in Parkinson's disease inpatients in the Basque country. *Parkinsonism Relat Disord.* 2017;36:57-62.
4. Derry CP, Shah KJ, Caie L, Counsell CE. Medication management in people with Parkinson's disease during surgical admissions. *Postgrad Med J.* 2010;86(1016):334-7.
5. *ACT on Time™ program*. Parkinson Canada; 2018 [cited 2020 Nov 16]. Available from: https://www.parkinson.ca/resources/act-on-time/
6. Delayed administration and contraindicated drugs place hospitalized Parkinson's disease patients at risk. Institute for Safe Medication Practices; 2015 Mar 15 [cited 2020 Nov 16]. Available from: https://www.ismp.org/resources/delayed-administration-and-contraindicated-drugs-place-hospitalized-parkinsons-disease
7. Reeder TA, Mutnick A. Pharmacist- versus physician-obtained medication histories. *Am J Health Syst.* 2008;65(9):857-60.
8. Johnston R, Saulnier L, Gould O. Best possible medication history in the emergency department: comparing pharmacy technicians and pharmacists. *Can J Hosp Pharm.* 2010;63(5):359-65.
9. Grissinger M. Delayed administration and contraindicated drugs place hospitalized Parkinson's disease patients at risk. *P T.* 2018;43(1):10-1.

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