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Tailoring the electronic health record to reduce inappropriate prescribing

INTRODUCTION

Inappropriate prescribing (IP) is prevalent in hospitalized older adults and associated with increased adverse drug events, functional decline, and costs.¹ Thus, studies have explored methods such as pharmacist medication review² and electronic health record (EHR)-based solutions, like clinical decision support (CDS) and alert systems,³ to decrease rates of IP in older adults. While effective, these interventions are resource intensive and, in the case of alert systems, can result in alert fatigue and variable acceptance of recommendations.³

EHR default doses are often higher than recommended for older adults.⁴ Studies by Peterson et al., 2005⁵ and Drago et al., 2020⁶ have shown that computerized provider order entry (CPOE) defaults can increase safe prescribing. Literature exploring defaults' effectiveness in decreasing IP has largely occurred in non-Hispanic White adults. This study seeks to contribute by examining an intervention at an academic medical center on Chicago's South Side, whose service population is comprised of 625,707 residents, with approximately 14.5% over 65 years old, 77% non-Hispanic Black/African American, and 53% living below 200% of the Federal Poverty Level.⁷

In February 2018, we implemented geriatric-specific CPOE defaults for 14 potentially high-risk medications (alprazolam, amitriptyline, clonidine, cyclobenzaprine, diazepam, digoxin, diphenhydramine, glipizide, glyburide, hydroxyzine, hyoscyamine, lorazepam, terazosin, zolpidem). While this intervention showed modest improvements in IP, a change was difficult to detect as

certain medications were infrequently used at our institution.⁸

To maximize the present study's impact, we first conducted a 1-year needs assessment characterizing the rate of IP for 20 potentially high-risk medications in hospitalized patients 65 years and older (clonazepam, dicyclomine, fentanyl, haloperidol, hydrocodone-acetaminophen, hydromorphone, ibuprofen, indomethacin, ketorolac, meclizine, megestrol, methocarbamol, metoclopramide, morphine, naproxen, olanzapine, oxycodone, quetiapine, risperidone, scopolamine).⁹ Guided by this needs assessment, we implemented geriatric-specific CPOE defaults for six medications with IP rates above 5% and frequently prescribed, and evaluated the intervention's effectiveness to reduce IP in hospitalized older adults.

METHODS

Our team, which included a geriatrician and geriatric clinical pharmacist, developed dosing recommendations for maximum single and daily doses from prescribing databases such as Lexicomp[®] (Wolters Kluwer Clinical Drug Information, Inc., Hudson, OH) and Micromedex[®] (IBM, Ann Arbor, MI), the AGS 2019 Beers Criteria,¹⁰ the STOPP criteria,¹¹ and the American Geriatrics Society's *Geriatrics at Your Fingertips*.¹²

At our institution medication orders are placed via the EHR system Epic[®] (Epic Systems Corporation, Verona, WI). Pharmacy Informatics implemented geriatric-specific CPOE defaults (Figure 1) in EHR order screens for inpatients 65 years and older for naproxen, ibuprofen, haloperidol, metoclopramide, morphine, and meclizine. Although order screens presented prescribers with preselected, recommended doses and frequencies,

Previous presentations: Preliminary data was presented at the American Geriatrics Society 2021 Annual Meeting.

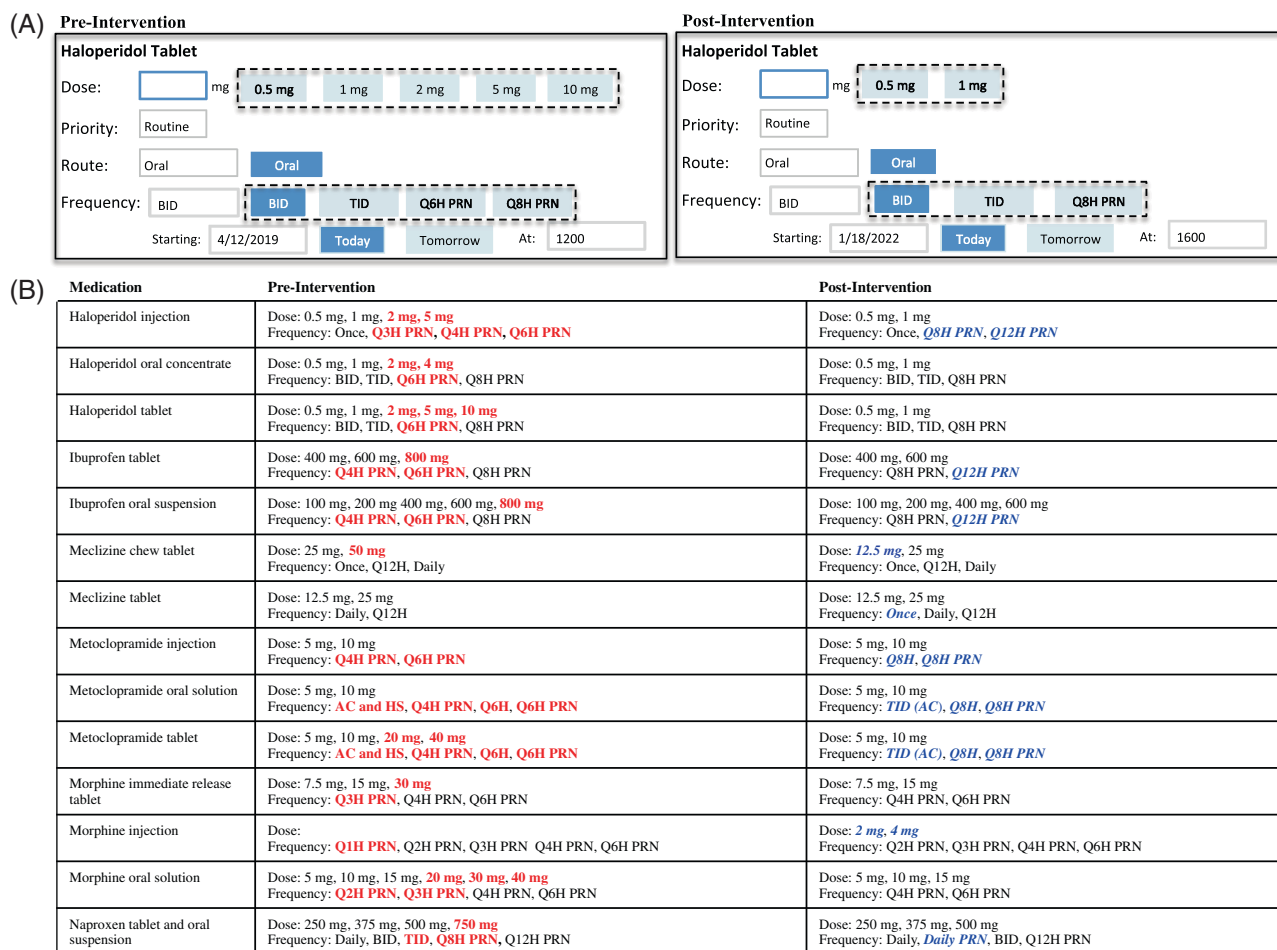


FIGURE 1 (A) Example of computerized provider order entry (CPOE) default in the electronic health record (EHR) pre- and post-intervention. (B) Table of geriatric-specific CPOE defaults in the EHR pre- and post-intervention. Red bolded text indicates those defaults that were removed in the intervention. Blue italicized text indicates those defaults that were added in the intervention. BID, twice daily; PRN, as needed; Q12H, every 12 h; Q2H, every 2 h; Q3H, every 3 h; Q4H, every 4 h; Q6H, every 6 h; Q8H, every 8 h; TID (AC), three times daily before meals; TID, three times daily

providers could enter a different dose or frequency as clinically appropriate.

As with our 2018 CPOE initiative, the intervention was discussed with and approved by key stakeholders, such as Pharmacy and Therapeutics and Pain Stewardship Committee members. Clinicians could use their clinical judgment to prescribe differently from the defaults, and so education was not provided when the CPOE defaults went live. The intervention was implemented on July 14, 2020, and as our dataset did not include the time orders were placed, we excluded this date from our analysis.

Prescribing data for targeted medications in inpatients 65 and older from July 2019 to 2021 were analyzed to assess intervention effectiveness. Orders prescribed via order sets and for patient-controlled analgesia were excluded. Orders that exceeded any one of our consensus upper limit dosing recommendations were classified as “inappropriate.” Data were analyzed in SAS version 9.4

(Cary, NC); chi-square and Fisher's exact test were used to compare proportions of IP pre- and post-intervention.

RESULTS

Pre-intervention (July 13, 2019–July 13, 2020) there were 755 orders for the targeted medications, with 54% for female and 65% for Black/African American patients, respectively. Post-intervention (July 15, 2020–July 15, 2021) there were 945 orders, with 49% for female and 67% for Black/African American patients, respectively. There were no statistically significant differences between the percent of orders for female/male and races pre- and post-intervention.

Post-intervention, the proportion of orders with IP for the targeted medications decreased significantly, 42%–35% ($p = 0.003$), with interrupted time series analysis showing an immediate and sustained decrease

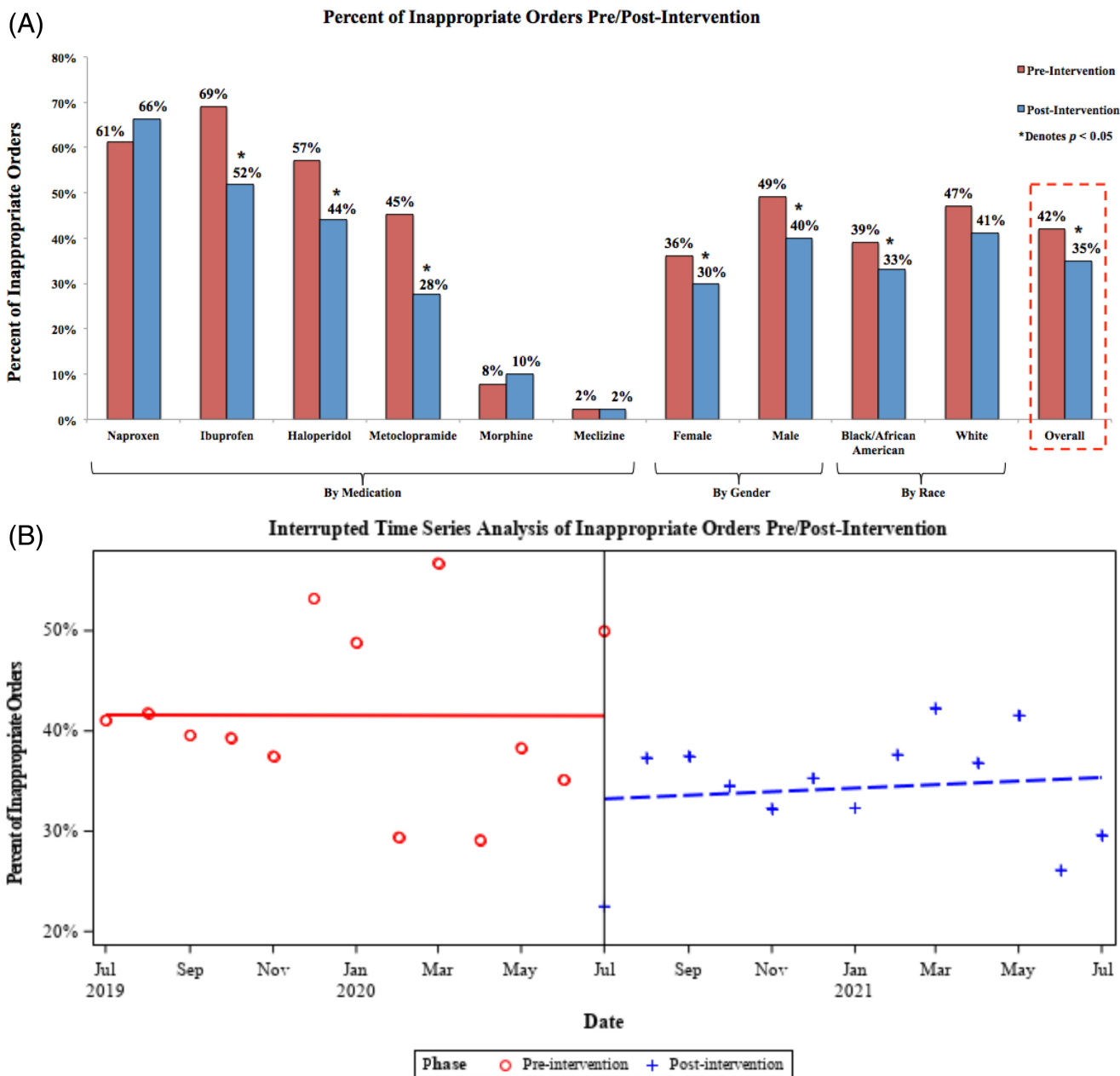


FIGURE 2 (A) Proportion of orders with inappropriate dosing pre- and post-intervention. Statistically significant changes denoted by *. (B) Interrupted time series analysis of all orders, pre- and post-intervention, depicting immediate and sustained decrease in inappropriate prescribing for intervention medications

in IP (Figure 2). Haloperidol, ibuprofen, and metoclopramide had statistically significant decreases in the proportion of IP orders ($p = 0.0005$, $p = 0.03$, $p = 0.047$, respectively) and meclizine was unchanged. The proportion of naproxen and morphine orders with IP increased slightly, 61%–66%, and 8%–10%, respectively, although these changes were not significant (Figure 2).

Additionally, the proportion of orders with IP decreased for male and female patients post-intervention (male: 49%–40%, $p = 0.01$; female: 36%–30%, $p = 0.04$). While inappropriately-prescribed orders for Black/African American patients decreased significantly post-

intervention, 39%–33% ($p = 0.047$), the decrease in inappropriately-prescribed orders for White patients was not significant, 47%–41% ($p = 0.19$).

DISCUSSION

This project resulted in a significant decrease in the overall proportion of orders with IP, confirming that CPOE defaults are a feasible method to improve medication safety for hospitalized older adults. Similar to prior studies, we found CPOE defaults' benefits to include ease of

implementation, low cost, sustainability, and the capability to encourage a behavior without interrupting providers' workflow. An additional benefit is the ability to tailor the intervention to institution-specific prescribing patterns.

Our work's generalizability is limited as it is a single institution study. We were unable to consider orders' clinical context due to the number of orders analyzed, thus some orders deemed inappropriate may have been appropriate for specific patients. Furthermore, because "as needed" orders were analyzed as though patients had received all potential doses, some overestimation of IP may have occurred. While order demographics pre- and post-intervention were similar, we did not collect patients' diagnoses, and therefore were unable to assess the potential effect of the COVID-19 pandemic on prescribing behavior and post-intervention results.

To maximize the impact of geriatric-specific CPOE defaults, we would recommend institutions first examine their EHR's default dosing for potentially high-risk medications in older adults, and then target those medications with inappropriate default dosing that are most frequently inappropriately prescribed. Overall, geriatric-specific CPOE defaults represent an effective mechanism institutions can tailor to their prescribing practices to reduce IP in hospitalized older adults.

AUTHOR CONTRIBUTIONS

Christine L. Mozer: Study design, interpretation of data, drafting of manuscript, reviewed and revised final submission. John F. Cursio: Data analysis, interpretation of data, reviewed and revised final submission. William Madden: Study concept and design, acquisition of data, reviewed and revised final submission. Tia Kostas: Study concept and design, interpretation of data, reviewed and revised final submission.

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CONFLICT OF INTEREST




The authors have no conflicts of interest relevant to this article to disclose.

SPONSOR'S ROLE

The sponsor did not play a role in this project.

ETHICS STATEMENT

This project received both a formal Determination of Quality Improvement status according to University of Chicago Medicine institutional policy, as well as approval from the University of Chicago Biological Sciences Division Institutional Review Board (IRB20-1926) for the efficacy analysis.

Christine L. Mozer BA¹ 
William Madden PharmD, BCGP²
John F. Cursio PhD³ 
Tia Kostas MD⁴ 

¹University of Chicago Pritzker School of Medicine,
Chicago, Illinois, USA

²Department of Pharmacy, University of Chicago, Chicago,
Illinois, USA

³Department of Public Health Sciences, University of
Chicago, Chicago, Illinois, USA


⁴Department of Medicine, Section of Geriatrics & Palliative
Medicine, University of Chicago, Chicago, Illinois, USA

Correspondence

Tia Kostas, Department of Medicine, Section of
Geriatrics & Palliative Medicine, University of Chicago,
5841 S. Maryland Avenue, MC 6098, Chicago, IL 60637,
USA.

Email: tkostas@medicine.bsd.uchicago.edu

ORCID

Christine L. Mozer  <https://orcid.org/0000-0002-9248-3577>

John F. Cursio  <https://orcid.org/0000-0003-2131-1767>

Tia Kostas  <https://orcid.org/0000-0003-2658-4713>

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Clinical outcomes of cardiovascular procedures in older patients with dementia

INTRODUCTION

Dementia and cardiovascular disease both affect many older adults in the United States and share several risk factors.^{1,2} The development of less invasive interventions has resulted in an increasing number of multimorbid older patients undergoing cardiovascular procedures, such as percutaneous coronary intervention and transcatheter aortic valve replacement, to decrease mortality or improve quality of life.^{3,4} This study aimed to evaluate the impact of dementia on the outcomes of common cardiovascular procedures.

METHODS

The study consisted of adults 65 years or older undergoing cardiovascular procedures between January 1, 2016 and March 31, 2018 within the Premier Healthcare Database, a hospital-based administrative database that covers 25% of annual inpatient admissions in the United States. Procedures were classified according to the Agency for Healthcare Research and Quality ([https://www.hcup-us.ahrq.](https://www.hcup-us.ahrq.gov/toolsoftware/ccs10/ccs10.jsp)

[gov/toolsoftware/ccs10/ccs10.jsp](https://www.hcup-us.ahrq.gov/toolsoftware/ccs10/ccs10.jsp)). Dementia was defined by the presence of the diagnosis codes in the Chronic Conditions Data Warehouse (<https://www2.ccwdata.org/web/guest/condition-categories>). We estimated the odds ratio (OR) and 95% confidence interval (CI) for in-hospital mortality and home discharge for patients with dementia compared to those without using logistic regression. The mean difference in length of stay (LOS) was estimated using linear regression with robust variance. Both regression models adjusted for age, sex, race, admission source, and Charlson comorbidity index. Generalized estimating equation was used to account for clustering of patients within hospitals. Analyses were performed using SAS 9.4 (SAS Institute Inc, Cary, NC). This study qualified for exemption from the Brigham and Women's Hospital Institutional Review Board.

RESULTS

The analysis included 759,887 patients undergoing cardiovascular procedures, of which 40,780 (5.4%) patients had a diagnosis of dementia. The mean age was 79 (SD,