Journal of Population Therapeutics & Clinical Pharmacology

Examining the Influence of Emergency Hospital Admissions and health management on Primary Care Prescription Patterns: A Retrospective Cohort Analysis of Electronic Records

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Abstract

Background: Understanding the impact of hospitalization on prescribing practices clinical settings remains limited.

Aim: This study aims to explore whether emergency hospital admissions contribute to increases in polypharmacy and potentially inappropriate prescriptions (PIPs).

Design and Setting: A retrospective cohort analysis conducted in primary and secondary care facilities .

Method: Changes in prescription numbers and incidence of PIPs were assessed following emergency hospital admissions , at admission, 4 weeks post-discharge, and 6 months post-discharge among 37,761 adult patients. Regression models were employed to examine shifts in prescribing patterns post-admission.

Results: Among 32,657 surviving emergency attendees after 6 months, the mean number of prescriptions increased from 4.4 (standard deviation [SD] = 4.6) before admission to 4.7 (SD = 4.7; P<0.001) 4 weeks post-discharge. Minor increases (<0.5) in prescriptions at 4 weeks were observed across most hospital specialties, except for surgery (–0.02; SD = 0.65) and cardiology (2.1; SD = 2.6). The incidence of PIPs rose post-hospitalization, with 4.0% of patients having ≥1 PIP before admission, increasing to 8.0% 4 weeks post-discharge. Specialty-wise, increases in PIP occurrence ranged from 2.1% in obstetrics and gynecology to 8.0% in cardiology. Patients were prescribed fewer medicines on average at 6 months post-discharge compared to 4 weeks (mean = 4.1; SD = 4.6; P<0.001), with PIP incidence decreasing to 5.4% (n = 1751) of patients.

Conclusion: Notions suggesting that hospitalization consistently leads to polypharmacy escalation are unfounded. Post-hospitalization increases in prescribing appear to reflect appropriate clinical responses to acute illness, whereas decreases are more likely among multimorbid patients, reflecting a focus on deprescribing and medicines optimization. However, concerns persist regarding the rise in PIPs.

Keywords: Hospital admission; Emergency department; Inappropriate prescribing; Polypharmacy; Primary care.

Introduction:

Prescribing stands as a paramount therapeutic intervention within clinical practice, primarily occurring in primary care settings where long-term conditions are increasingly managed. Over time, medication use has seen a steady rise, evidenced by the doubling proportion of UK patients receiving five or more drugs between 1995 and 2010. Polypharmacy, defined as the prescribing of multiple medications, is propelled by various factors including an aging population, multimorbidity, and guideline-driven prescribing for individual conditions. This phenomenon is associated with medication errors, adverse reactions, diminished quality of life, and impaired medication adherence. (Cassell et al., 2018)

Transitions in care can significantly affect the quality and continuity of pharmacotherapy. Previous studies have indicated that many patients experience alterations to their medication regimen following hospitalization, particularly substantial changes at discharge, including an uptick in potentially inappropriate prescriptions (PIPs). PIPs refer to prescriptions where the risks outweigh the benefits, often due to contraindications. However, it remains unknown whether similar trends are observed in UK clinical practice, given the disparities in health service structures and processes. Moreover, prior research in this area has been hindered by limitations such as small sample sizes, narrow clinical focus, or methodological constraints. (Komagamine et al., 2018)

Enhancing our comprehension of medication changes post-hospitalization holds significance as it can inform medicine reconciliation, a critical aspect of high-quality care that is susceptible to improvement. This study seeks to investigate the impact of a single emergency admission on alterations in overall prescribing practices and the incidence of PIPs , while also exploring potential variations across hospital specialties. (Tan et al., 2014)

METHOD:

Study Population:

Anonymized data from the Clinical Practice Research Datalink (CPRD) were utilized for a descriptive analysis. The CPRD comprises anonymized electronic health records from primary care, encompassing over 5 million active patients from around 650 general practices, and is deemed representative of the general population. This database contains coded information on clinical diagnoses and prescribed medications.

A random sample of 100,000 patients, the maximum available for this study, aged 18 years or older, who were admitted to hospitals , was identified using linked Hospital Episode Statistics (HES) data. The analysis was specifically focused on emergency admissions. HES provides coded data, including dates, diagnoses, and hospital specialties, regarding most hospital inpatient admissions. The initial hospital admission, inclusive of readmissions within 6 weeks post-discharge, was delineated as the index admission. Patients were excluded if they had been hospitalized within one year preceding the index admission to mitigate the influence of prior hospital stays on changes to prescriptions. Maternity admissions directly related to childbirth were also excluded from the analysis.

Measurements:

The study assessed the number of ongoing prescriptions at the index admission, and at 4 weeks and 6 months post-discharge. An ongoing prescription was defined as one that encompassed the date of interest within its usage period. Prescription length was computed by dividing drug quantity by the number of daily doses; in cases of missing data, a population average was utilized. Prescriptions were categorized according to the British National Formulary (BNF) and limited to pharmacological products within BNF chapters 1–15.

Counts of all ongoing prescriptions were tabulated at each time point, stratified by BNF chapter. A categorical count of all ongoing prescriptions of unique drugs at the index admission was created, ranging from 0 to ≥15 prescriptions based on pragmatic and clinical judgment. Two continuous measures were formulated to detail the change in the number of prescriptions relative to the index admission in the short term (4 weeks) and long term (6 months), categorized into five groups: reductions of 1 drug, reductions of ≥2 drugs, no change, increases of 1 drug, or increases of ≥2 drugs.

Potentially inappropriate prescriptions (PIPs) were identified based on 19 Royal College of General Practitioners (RCGP) inappropriate prescribing indicators, which have been used in clinical trials and are implemented in practice. These indicators encompassed prescribing within particular contraindications or drug–drug interactions. Binary measures indicating whether the patient had ≥1 PIP at the index admission, 4 weeks, and 6 months post-discharge were generated.

Hospital specialty, responsible for primary patient care, was determined based on the longest episode of care during each admission and grouped according to national patterns. Duration of index hospitalization, number of readmissions, and number of admissions within 6 months post-discharge were calculated. Comorbidity status at hospitalization was assessed using a list of 37 physical and mental long-term conditions, with a six-category measure derived based on the count of clinical conditions.

Statistical Analysis:

Descriptive analyses were employed to explore prescribing patterns before and after the index admission, focusing on patients surviving 6 months post-discharge. Multilevel linear regression models were fitted to outcomes by hospital specialty. Marginal effects were estimated to represent changes in prescription numbers, averaged across patients. Multilevel logistic regression was used to calculate odds ratios (ORs) and 95% confidence intervals (CIs) for having a PIP at various time points, adjusting for covariates. Sensitivity analyses were conducted to assess potential biases and explore regression to the mean. Data analysis was performed using Stata (version 15), with two-sided statistical tests.

Sensitivity Analysis:

Models were repeated to include all patients alive at 4 weeks post-discharge to evaluate potential biases from restricting analysis to those surviving 6 months post-discharge. Regression to the mean was explored across grouped prescription numbers before hospitalization, comparing expected and observed estimates.

RESULTS

Study Population Characteristics:

A total of 37,761 emergency attendances were identified, with 34,815 and 32,657 patients surviving at 4 weeks and 6 months post-discharge, respectively. Patients surviving at 6 months had fewer prescriptions at hospitalization (mean = 4.4; SD = 4.6) compared to those who died (n = 5115) (mean = 6.3; SD = 4.7) and fewer comorbidities (≥5 conditions: 8.5% versus 18.1%; P<0.001). The mean age of patients surviving at 6 months was 58.7 years (SD= 21.3), with 54.0% being female, and 50.7% having ≥2 comorbidities. The average duration of hospitalization was 2 days, and 22.9% of patients were readmitted within 6 months post-discharge.

Number of Prescriptions Following Hospital Discharge:

Patients had a mean of 4.4 (SD = 4.6) prescriptions before admission and a mean of 4.7 (SD = 4.7; P<0.001) at 4 weeks post-discharge. Increases in prescribing were observed across all patients irrespective of sex, age, or multimorbidity status. Patients with fewer prescriptions pre-hospitalization received more afterward, while those with more prescriptions received fewer following hospitalization. These findings were consistent with regression to the mean.

Potentially Inappropriate Prescribing Following Hospital Discharge:
The proportion of patients with PIPs increased from 4.0% pre-admission to 8.0% at 4 weeks post-discharge. Significant increases were noted in patients with a history of heart failure prescribed NSAIDs and those prescribed warfarin and aspirin without gastroprotection. Similar patterns were observed across hospital specialties.

Sustained Changes in Prescribing 6 Months After Hospitalization:
Patients were prescribed fewer medications at 6 months post-discharge (mean = 4.1; SD = 4.6) compared to pre-admission and at 4 weeks post-discharge. Decreases in prescribing at 6 months were observed across specialties, ranging from 0.2 in O&G to 0.9 in cardiology and other medicines. The proportion of patients with PIPs decreased to 5.4% at 6 months, although still higher than at admission.

Sensitivity Analysis:
No differences were observed in the sensitivity analysis, which included all patients alive at 4 weeks post-discharge.

DISCUSSION

Summary:
This study presents the first comprehensive assessment of the impact of emergency hospitalization on prescribing practices in primary care . Findings indicate an overall increase in prescribing following discharge, followed by a decrease to below pre-hospitalization levels within 6 months. While variations in prescribing changes across hospital specialties were minimal, statistically significant long-term increases were observed in cardiology admissions. Additionally, the study highlights a concerning rise in potentially inappropriate prescriptions (PIPs) following hospitalization, persisting in both short and long-term periods. (Gutiérrez-Valencia et al., 2017)
Hospitalization entails significant alterations to medication regimens, particularly notable among certain patient groups and hospital specialties. Contrary to common perceptions, the notion that hospital admission consistently drives rises in polypharmacy is unfounded. The observed increase in PIPs underscores the need for improved, targeted medication optimization strategies for patients discharged from hospitals, particularly those most susceptible to medication changes. (Chang et al., 2017)

Strengths and Limitations:
This study is among the largest to investigate changes in prescribing following emergency hospitalization, exploring differences by hospital specialty and including younger patients. Utilizing detailed data on medical history, primary care prescribing, and hospital admissions lends robustness to the findings. However, limitations include the inability to determine actual discharge prescriptions, potentially leading to discrepancies between hospital recommendations and post-discharge prescriptions. Furthermore, the study's measures of medication use and appropriateness are somewhat broad and may not fully capture the risk-benefit balance. Excluding patients with prior admissions in the past year may limit generalizability, and the lack of a comparative group

precludes definitive attribution of observed changes to the hospital admission itself. (Rouch et al., 2018)

Comparison with Existing Literature:

While existing literature reports varying degrees of drug changes pre- and post-hospitalization, with up to 75% of patients experiencing alterations, this study found approximately 50% of patients undergoing medication changes following discharge. Consistent with prior research, the study observed a decline in prescribing 6 months post-discharge, indicative of potential improvements in patients' health or ongoing medication optimization. The increase in PIPs following discharge aligns with findings elsewhere, although discrepancies may stem from differences in PIP definitions and study populations. (Barnett et al., 2012)

Implications for Research and Practice:

Medication reconciliation plays a crucial role in delivering high-quality care and optimizing prescribing practices across the primary-secondary care interface. This study underscores that post-hospitalization changes in prescribing are more prevalent among patients with fewer pre-existing conditions or medications. This likely reflects an appropriate clinical response to new acute illness in relatively healthier patients, contrasting with a greater emphasis on deprescribing and medicines optimization in those with multiple comorbidities. Variations observed between specialties, particularly the marked increases following discharge from cardiology, may reflect the specialty's culture of evidence-based drug use.

The absence of a significant reduction in prescribing among patients admitted to geriatric care is unexpected and may be influenced by external service pressures or study population restrictions. Increases in PIPs post-discharge are unlikely to solely result from increased prescribing but may indicate a shift in the risk-benefit balance of certain medications, potentially favoring more hazardous prescribing in acutely ill patients. This raises concerns regarding clinician awareness of PIPs or potential compromises in pharmacological management due to pressures to minimize hospital stays.

Therefore, medication optimization should be integrated as a routine aspect of early post-hospital follow-up, particularly targeting patients at high risk of medication changes and PIPs. However, whether early intervention can influence long-term prescribing changes observed post-discharge in this study remains unclear and warrants further investigation.

Future research should focus on evaluating the effectiveness of early intervention strategies in mitigating long-term prescribing changes and PIPs post-hospitalization. Additionally, studies exploring the impact of external factors, such as service pressures, on medication optimization practices in different specialties and patient populations are necessary to inform targeted interventions and improve patient outcomes.

References

1. Guthrie B, Makubate B, Hernandez-Santiago V, Dreischulte T. The rising tide of polypharmacy and drug-drug interactions: population database analysis 1995–2010. BMC Med. 2015;13:74.
2. Payne RA, Avery AJ, Duerden M, et al. Prevalence of polypharmacy in a Scottish primary care population. Eur J Clin Pharmacol. 2014;70(5):575–581.
3. Duerden M, Avery AJ, Payne RA. Polypharmacy and medicines optimisation: making it safe and sound. 2013. Available from: https://www.kingsfund.org.uk/sites/default/files/field/field_publication_file/polypharmacy-and-medicines-optimisation-kingsfund-nov13.pdf.

4. Avery T, Barber N, Ghaleb M, et al. Investigating the prevalence and causes of prescribing errors in general practice: the PRACtICe study. 2012. Available from: https://uhra.herts.ac.uk/bitstream/handle/2299/13716/Investigating_the_prevalence_and_causes_of_prescribing_errors_in_general_practice_The_PRACtICe_study_Report_May_2012_48605085.pdf.
5. Dequito AB, Mol PG, van Doormaal JE, et al. Preventable and non-preventable adverse drug events in hospitalized patients: a prospective chart review in the Netherlands. Drug Saf. 2011;34(11):1089–1100.
6. Montiel-Luque A, Núñez-Montenegro AJ, Martin-Aurioles E, et al. Medication-related factors associated with health-related quality of life in patients older than 65 years with polypharmacy. PLoS One. 2017;12(2):e0171320.
7. Vik SA, Maxwell CJ, Hogan DB. Measurement, correlates, and health outcomes of medication adherence among seniors. Ann Pharmacother. 2004;38(2):303–312.
8. Himmel W, Kochen MM, Sorns U, Hummers-Pradier E. Drug changes at the interface between primary and secondary care. Int J Clin Pharmacol Ther. 2004;42(2):103–109.
9. Viktil KK, Blix HS, Eek AK, et al. How are drug regimen changes during hospitalisation handled after discharge: a cohort study. BMJ Open. 2012;2(6):e001461.
10. Gamble J-M, Hall JJ, Marrie TJ, et al. Medication transitions and polypharmacy in older adults following acute care. Ther Clin Risk Manag. 2014;10:189–196.
11. Lund BC, Schroeder MC, Middendorff G, Brooks JM. Effect of hospitalization on inappropriate prescribing in elderly Medicare beneficiaries. J Am Geriatr Soc. 2015;63(4):699–707.
12. Perez T, Moriarty F, Wallace E, et al. Prevalence of potentially inappropriate prescribing in older people in primary care and its association with hospital admission: longitudinal study. BMJ. 2018;363:k4524.
13. Page RL 2nd, Linnebur SA, Bryant LL, Ruscin JM. Inappropriate prescribing in the hospitalized elderly patient: defining the problem, evaluation tools, and possible solutions. Clin Interv Aging. 2010;5:75–87.
14. Care Quality Commission. Managing patients' medicines after discharge from hospital. 2009. Available from: https://webarchive.nationalarchives.gov.uk/20101122140156/http://www.cqc.org.uk/_db/_documents/Managing_patients_medicines_after_discharge_from_hospital.pdf.
15. Herrett E, Gallagher AM, Bhaskaran K, et al. Data resource profile: Clinical Practice Research Datalink (CPRD). Int J Epidemiol. 2015;44(3):827–836.
16. Herrett E, Thomas SL, Schoonen WM, et al. Validation and validity of diagnoses in the General Practice Research Database: a systematic review. Br J Clin Pharmacol. 2010;69(1):4–14.
17. Herbert A, Wijlaars L, Zylbersztejn A, et al. Data resource profile: Hospital Episode Statistics Admitted Patient Care (HES APC). Int J Epidemiol. 2017;46(4):1093–1093i.
18. Joint Formulary Committee. British National Formulary (BNF) 69. London: BMJ Group and Pharmaceutical Press; 2015.
19. Stocks SJ, Kontopantelis E, Akbarov A, et al. Examining variations in prescribing safety in UK general practice: cross sectional study using the Clinical Practice Research Datalink. BMJ. 2015;351:h5501.
20. Spencer R, Bell B, Avery AJ, et al. Identification of an updated set of prescribing-safety indicators for GPs. Br J Gen Pract. 2014. DOI: https://doi.org/10.3399/bjgp14X677806.

21. Avery AJ, Rodgers S, Cantrill JA, et al. A pharmacist-led information technology intervention for medication errors (PINCER): a multicentre, cluster randomised, controlled trial and cost-effectiveness analysis. Lancet. 2012;379(9823):1310–1319.
22. NHS Digital. Hospital admitted patient care activity, 2016–17. 2017. Available from: https://digital.nhs.uk/data-and-information/publications/statistical/hospital-admitted-patient-care-activity/2016-17.
23. Cassell A, Edwards D, Harshfield A, et al. The epidemiology of multimorbidity in primary care: a retrospective cohort study. Br J Gen Pract. 2018. DOI: https://doi.org/10.3399/bjgp18X695465.
24. Barnett K, Mercer SW, Norbury M, et al. Epidemiology of multimorbidity and implications for health care, research, and medical education: a cross-sectional study. Lancet. 2012;380(9836):37–43.
25. University of Cambridge. Primary Care Unit. CPRD @ Cambridge — [ARCHIVED] Code Lists Version 1.0 — August 2017. 2017. Available from: https://www.phpc.cam.ac.uk/pcu/cprd_cam/v10.
26. Steventon A, Deeny S, Friebel R, et al. Briefing: Emergency hospital admissions in England: which may be avoidable and how? 2018. Available from: https://www.health.org.uk/sites/default/files/Briefing_Emergency%2520admissions_web_final.pdf.
27. Wawruch M, Zikavska M, Wsolova L, et al. Polypharmacy in elderly hospitalised patients in Slovakia. Pharm World Sci. 2008;30(3):235–242.
28. Rouch L, Farbos F, Cool C, et al. Hospitalization drug regimen changes in geriatric patients and adherence to modifications by general practitioners in primary care. J Nutr Health Aging. 2018;22(3):328–334.
29. Tan B, Mulo B, Skinner M. Transition from hospital to primary care: an audit of discharge summary — medication changes and follow-up expectations. Intern Med J. 2014;44(11):1124–1127.
30. Blozik E, Signorell A, Reich O. How does hospitalization affect continuity of drug therapy: an exploratory study. Ther Clin Risk Manag. 2016;12:1277–1283.
31. Chang WT, Kowalski SR, Sorich W, Alderman CP. Medication regimen complexity and prevalence of potentially inappropriate medicines in older patients after hospitalisation. Int J Clin Pharm. 2017;39(4):867
32. Gutiérrez-Valencia M, Izquierdo M, Malafarina V, et al. Impact of hospitalization in an acute geriatric unit on polypharmacy and potentially inappropriate prescriptions: a retrospective study. Geriatr Gerontol Int. 2017;17(12):2354–2360.
33. Komagamine J, Hagane K. Prevalence of potentially inappropriate Kampo medications among elderly patients taking any prescribed Kampo medications at a single centre in Japan: a retrospective cross-sectional study. BMC Altern Med. 2018;18(1):155.