Medication Burden in Patients With Acute Coronary Syndromes

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ABSTRACT

OBJECTIVES: Cardioprotective medications improve outcomes following acute coronary syndromes (ACS) but add to medication complexity. We set out to describe the use of these medications and quantify medication changes in patients admitted and discharged for ACS.

STUDY DESIGN: Retrospective cohort study.

METHODS: Using archived data from the electronic health record (EHR), we evaluated patients with ACS admitted to 1 of 2 hospitals between January 2008 and December 2012. Patients aged 18 to 89 years who were discharged with a principal diagnosis of ACS were included in the study. Descriptive statistics were compiled and medication use was compared at 3 time points: admission, discharge, and within 90 days post discharge.

RESULTS: This study included 4767 patients. The mean number of total medications increased from 8.6 ± 6.5 to 11.4 ± 5.4 from admission to discharge, dropping slightly within 90 days post discharge (11.1 ± 5.2). Patients taking medications at least twice daily increased from 6.4 of 10 at admission to 9 of 10 at discharge. Cardioprotective medication use increased by a relative 76% for aspirin, 72% for statins, 85% for beta-blockers, and 29% for angiotensin-converting enzyme inhibitors/angiotensin II receptor blockers from admission to discharge, whereas $P2Y_{12}$ receptor inhibitor use increased 4-fold.

CONCLUSIONS: Medication complexity among patients with ACS are high, with notable changes from admission to discharge. Awareness of the extent of medication burden provides clinicians and policy makers with insight to help address medication use during the ACS peri-hospitalization period.

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Acute coronary syndromes (ACS), encompassing ST-segment elevation myocardial infarction (STEMI), non-ST-segment elevation myocardial infarction (NSTEMI), and unstable angina, are responsible for significant patient morbidity and mortality and are frequent causes of hospital admissions. Although the incidence of ACS and related coronary heart disease (CHD) has declined in recent decades,[1] CHD remains the leading cause of mortality (approximately one-third of all deaths).[2] Improvements in ACS outcomes have largely been attributed to reductions in major risk factors and advances in acute therapies, including coronary perfusion through percutaneous coronary intervention (PCI), coronary artery bypass grafting, and improved medication management using 1 or more of the 5 major classes of cardioprotective agents: aspirin, $P2Y_{12}$ receptor inhibitors, beta-blockers, angiotensin-converting enzyme (ACE) inhibitors or angiotensin II receptor blockers (ARBs), and 3-hydroxy-3-methylglutaryl-coenzyme A reductase inhibitors (ie, statins).[3,4] Optimal medication management during and following admission for ACS is critical to improving patient outcomes.[4]

High rates of medication nonadherence are major contributors to poor outcomes following ACS.[5,6] Approximately one-third of patients will discontinue 1 or more cardiovascular medications within 3 months of discharge following admission for ACS,[7] with over half reporting nonadherence at 10 months.[8] Among other reasons, complex medication regimens and a high overall medication burden are directly related to medication nonadherence.[7,9] Medication complexity, including an increased number of medications being taken regularly, frequency of use, and special instructions (eg, take on an empty stomach, separate levothyroxine from calcium carbonate), is challenging enough for patients after discharge from an ACS admission, but confusing or unclear instructions can further complicate matters.[10] Quantification of patients' medication regimens and modifications to drug therapy during the peri-hospitalization period (ie, from admission to 90 days post discharge) in the real-world environment versus clinical trials is important to make valid inferences in usual practice.[11] The

exact extent of medication regimen complexity, as defined by the number and frequency of all medications, and how this changes from admission to discharge following ACS, have yet to be described in a real-world setting.

The following descriptive study aimed to characterize the prescribing patterns of cardioprotective medications, determine the extent of the medication burden by number and frequency of medications taken per day, and compare the medication burden and frequency from admission to discharge among a cohort of patients with ACS.

TAKEAWAY POINTS

- Patients admitted for acute coronary syndrome (ACS) leave the hospital with an increased medication burden.
- Among patients with ACS, the complexity of medication regimens increases from admission to discharge.
- Although medication use increased following admission for ACS, the majority of patients are not prescribed all recommended evidenced-based medications upon discharge.

METHODS

Study Design

We conducted a retrospective descriptive analysis of patients with ACS admitted to either of 2 Geisinger hospitals between January 1, 2008, and December 31, 2012.

Setting

Geisinger Health System (GHS) is an integrated healthcare delivery system offering services to residents of 44 of the state's 67 counties in central and northeastern Pennsylvania. GHS includes the Geisinger Clinic, which provides ambulatory care to approximately 350,000 patients annually across 44 community-based practices; the Geisinger Health Plan, an insurance plan with over 450,000 covered lives; the Geisinger medical laboratory, a private lab that services all GHS facilities; 2 large tertiary care teaching hospitals; and 6 smaller community hospitals.

Data Sources

Study data were extracted from GHS's electronic health record (EHR), EpicCare (Epic Systems Corporation; Madison, Wisconsin), which contains information for more than 2.5 million patients and has been fully operational since 2001 and 2007 in the outpatient and inpatient settings, respectively. The EHR archives information on patient demographics, medication order history, medical notes, encounters, orders, medication administration record, appointments, imaging, laboratory, and billing data every 24 hours onto duplicate servers for both clinical and nonclinical accessibility.

Study Population

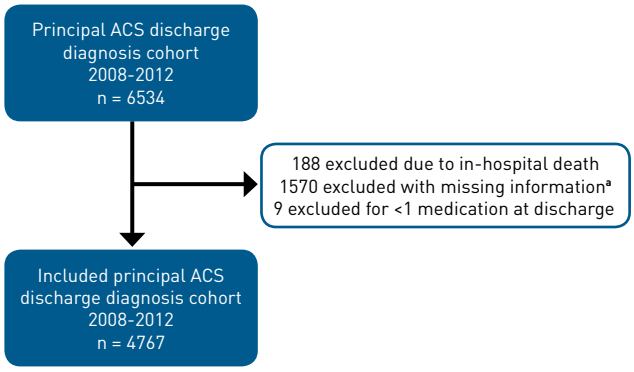
Patients were included in the study cohort if they were at least 18 but younger than 90 years; admitted to either of 2 Geisinger hospitals between January 1, 2008, through December 31, 2012; and were discharged from the hospital with a principal discharge diagnosis of ACS, as identified by *International Classification of Diseases, Ninth Revision* (*ICD-9*) codes: 410.00, 410.01, 410.10, 410.11, 410.20, 410.21, 410.30,410.31, 410.40, 410.41, 410.50, 410.51, 410.60, 410.61, 410.80, 410.81; 410.70, 410.71; 410.90, 410.91; 411.1. In this analysis, the focus was on the index ACS admission, defined as the first ACS admission in the EHR during the study period with no ACS-related admissions occurring in the prior 6 months. Patients were excluded if they had a research exclusion flag in the EHR, were treated with ticagrelor due to low sample size (internal analysis revealed only 1 patient with use in 2011 and 13 patients with use in 2012), or died during hospitalization. In addition, we excluded patients who had missing or incomplete information, including any patients who did not have an encounter ID on file for the listed principal ACS admission. The lack of an encounter ID was mainly due to the initiation of the EHR within 1 hospital during the 2008 to 2009 period.

Methodological Approach

This analysis focused on describing medication use during the index ACS period. We characterized our population in terms of concomitant conditions (ie, from *ICD-9* codes present on the patient's prior to admission [PTA] problem list), inpatient laboratory tests (including cardiac troponins, lipid panel, serum creatinine concentration), length of stay, in-hospital events (including PCI), postdischarge events (including rehospitalization due to ACS), other rehospitalizations, mortality, and revascularization within 30 days and 3 months of the index admission.

Among our cohort, we evaluated medication use at 3 different time points: index admission, discharge, and post discharge up to 90 days (for those with a return visit). Admission medications were identified using the PTA medication list recorded in the EHR. PTA medications are self-verified by patients during the admission intake process from medication lists current in the EHR at the time of admission (available for 55% of patients seen by a Geisinger provider in the previous 12 months, in addition to those previously admitted to a Geisinger facility, and those with medication lists in the Geisinger system that are more than 12 months old), lists of medications filled at pharmacies that are imported into the EHR, or no previous record (in which case the PTA medication list was self-reported only) in some cases. If the PTA medication list was not available, but the patient was seen any time previously by a provider in the Geisinger Clinic, the most recent outpatient medication list was used to populate the admission medication list. PTA medica-

FIGURE 1. Flow Diagram of Patients Included in the Cohort



ACS, acute coronary syndrome; EHR, electronic health record.

[a]Primarily due to lack of electronic encounter ID due to new installation of EHR in 2008 and 2009.

tion lists include prescription and nonprescription medications. Discharge medications were determined from the discharge orders. Finally, for those with a postdischarge visit, we used the outpatient reconciled medication list for the postdischarge follow-up at the latest visit from hospitalization up to 90 days post discharge.

We quantified the use of medication classes recommended for use in patients with ACS, which included aspirin, $P2Y_{12}$ receptor inhibitors, statins, ACE inhibitors or ARBs, and beta-blockers. Medication complexity was quantified by 2 separate measures: total number of medications and medication frequency (defined as the number of times a day a medication is to be taken). Assessment of medication complexity was quantified for all cardiac and noncardiac traditional medications. Over-the-counter and as-needed medications (eg, ibuprofen, ranitidine, aspirin) were included, as they are often prescribed by a provider for a select indication; however, complementary and alternative medications and vitamins were excluded because our focus was on traditional medication use.

Free-text medication instructions for use (also known as signa or "sig") in the EHR admission, and discharge and postdischarge medication lists, were mapped by a custom algorithm developed internally for mapping free-text sig instructions to a standardized set of medication frequency instructions. The time of day was not specified in the logic; only frequency on a numeric scale of times a medication was given per day. For example, a patient prescribed lisinopril 10 mg in the morning, simvastatin 20 mg in the evening, and metformin 500 mg twice daily would have a total daily medication frequency of 1 for both lisinopril and simvastatin, and 2 for metformin. After assessing all medications within a patient's profile, the medication with the highest frequency per day was assigned as the minimum frequency a patient took medications per day. In this same example, the patient would be listed as having a minimum frequency per day of 2. This methodology represents the most conservative daily estimate of administration frequencies, biasing frequency toward the lower end.

Statistical Analysis

Treatment groups were summarized with respect to demographic and clinical characteristics. Descriptive summary statistics, including, means, medians, standard deviations, and interquartile ranges, are presented for continuous variables. Distributions of categorical variables were characterized by proportions. Comparisons of the number of medications between peri-hospitalization time points were conducted using paired *t* tests and the frequency of the medication was tested using χ^2 tests. All analyses were performed using SAS version 9.3 software (SAS Institute; Cary, North Carolina).

RESULTS

After applying exclusion criteria, 4767 patients with a discharge diagnosis for ACS were included in the study cohort (**Figure 1**). Complete medication information was available for all 4767 patients during hospitalization and at discharge. A total of 4559 patients had PTA medication data that were derived from either the patient-verified list confirmed at the time of admission (3923 patients; 82.3%) or, if that list was not confirmed, from the medication list in the EHR documented prior to hospitalization (636 patients; 13.3%). The 208 patients (4.4%) with no medications within their PTA list or within the EHR were assumed to take no medications on arrival.

Table 1 describes the basic demographic and clinical characteristics of the study cohort. The average age of the cohort was 64.7 years, and the majority were male (64.6%) and white (98.5%). Most patients were current nonsmokers, with over 43% reporting a prior smoking history. Both the mean (30.7) and median (29.8) body mass index (BMI) indicate a predominantly overweight/obese population, with approximately 82% of the cohort having a BMI greater than 25. ACS breakdown revealed 33.6% had an STEMI, 42.7% had an NSTEMI, and 23.6% had unstable angina. The most common comorbidities included coronary artery disease, hypertension, hyperlipidemia, diabetes, and heart failure.

Table 2 displays the medication use by number and frequency used in the peri-hospitalization period. On average, patients were prescribed 8.6 medications on admission, which increased by an average of 2.8 medications to 11.4 on discharge ($P < .001$). Similar increased medication burden was found for patients after discharge (within 90 days after discharge) compared with admission (mean difference = 2.5; $P < .001$). Among those with both discharge and 90-day follow-up data (n = 3285), total medications per patient at discharge (11.7 ± 5.3) was slightly higher than during the posthospitalization period (mean difference = 0.4; $P = .02$).

Most patients throughout the peri-hospitalization period were prescribed regularly scheduled medications. On admission, over

TABLE 1. Demographic and General Patient Characteristics for Index Hospitalization for Principal ACS Discharge Diagnosis Cohort From 2008-2012

Characteristic	Value
Age in years at admission, n (mean ± SD)	4767 (64.7 ± 12.5)
Male gender, n (%)	3078 (64.6%)
White race, n (%)	4702 (98.6%)
Current smoker (at admission), n (%)	778 (16.8%)
Length of inpatient stay, mean ± SD	5.1 ± 6.3
BMI in kg/m^2 at admission, n (mean ± SD)	4767 (30.8 ± 6.8)
ACS breakdown, n (%)	
STEMI	1602 (33.6%)
NSTEMI	2040 (42.8%)
Unstable angina	1125 (23.6%)
Select preadmission diagnoses, n (%)	
Coronary artery disease	3599 (75.5%)
Prior percutaneous coronary intervention	1075 (22.6%)
Prior CABG	244 (5.1%)
Peripheral vascular disease	512 (10.7%)
Cerebral vascular accident/prior TIA	557 (11.7%)
Heart failure	1160 (24.3%)
Atrial fibrillation	797 (16.7%)
Hypertension	2890 (60.6%)
Hyperlipidemia	2564 (53.8%)
Diabetes (type 1 or 2)	1630 (34.2%)
Renal disease	499 (10.5%)
Depression	483 (10.1%)
Any cancer	504 (10.6%)
Intervention (within ACS hospitalization), n (%)	
None	1930 (40.5%)
PCI with BMS only	1527 (32.0%)
PCI with ≥1 DES	866 (18.2%)
CABG	466 (9.8%)

ACS, acute coronary syndrome; BMI, body mass index; BMS, bare-metal stent; CABG, coronary artery bypass graft; DES, drug-eluding stent; NSTEMI, non-ST-segment elevated myocardial infarction; PCI, percutaneous coronary intervention; STEMI, ST-segment elevated myocardial infarction; TIA, trans-ischemic attack.

TABLE 2. Medication Totals and Frequencies for Traditional Medications During ACS Peri-Hospitalization Period

	Admission N = 4767	Discharge N = 4767	Follow-up (90 days) N = 3285
Mean number of medications, n (SD)	4767 (8.6 ± 6.5)	4767 (11.4 ± 5.4)	3285 (11.1 ± 5.2)
Median (IQR) number of medications	7.0 (4.0 -12.0)	10.0 (7.0 – 14.0)	10.00 (7.0 – 14.0)
Medication schedule			
No oral medications	294 (6.2%)	4 (0.1)%	31 (0.9%)
PRN only	94 (2.0%)	8 (0.2%)	4 (0.1%)
Once daily	1354 (28.4%)	440 (9.2%)	577 (17.7%)
Twice daily	1996 (41.9%)	3164 (66.4%)	2070 (63.6%)
3 times a day	746 (15.7%)	845 (17.7%)	461 (14.2%)
4 times a day	264 (5.5%)	294 (6.2%)	135 (4.2%)
5 times a day	16 (0.3%)	7 (0.2%)	5 (0.2%)
≥6 times a day	3 (0.1%)	5 (0.1%)	2 (0.1%)

ACS, acute coronary syndrome; IRQ, interquartile range; PRN, pro re nata (as needed); SD, standard deviation.

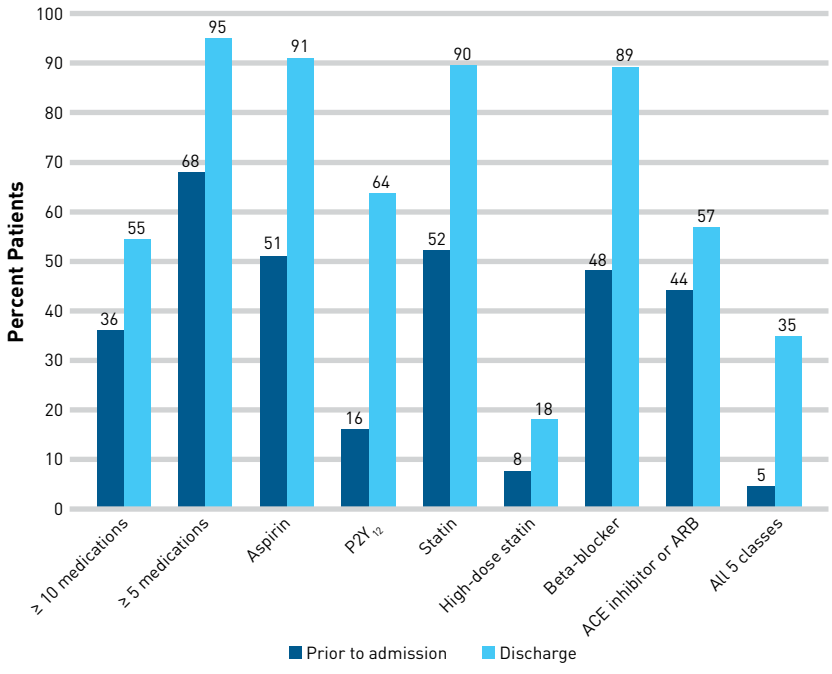
35% were taking a medication only once a day, as needed, or no medications (**Figure 2**). This proportion dropped to less than 10% at discharge. In total, 90.5% of patients at discharge were taking at least 1 medication twice a day or more, but this proportion dropped slightly, to 81.2%, at follow-up (P <.001).

Cardioprotective medication use during the index ACS peri-hospitalization period is reported in **Table 3**. On admission to the hospital, less than 5% of patients were taking all 5 medication classes. Statins were the highest used medication class, with 52.2% of patients prescribed a statin prior to admission, followed by any use of aspirin at 51.4%. $P2Y_{12}$ receptor inhibitors were the least prescribed medication class prior to admission (16.1%). Cardioprotective medication use increased across all 5 medication classes from admission to discharge. There was a relative increase in use from admission to discharge of 76% for aspirin, 72% for statins, 85% for beta-blockers, and 29% for ACE inhibitors or ARBs. $P2Y_{12}$ receptor inhibitor use increased 4-fold. ACE inhibitor or ARB use only slightly increased from admission to discharge (44.1%-56.8%) and was the least prescribed agent among the 5 classes on discharge (Figure 2). Patients admitted for an STEMI (n = 1602; 69.5%) were 2.2 times (odds ratio [OR], 2.2; 95% confidence interval [CI], 1.9-2.5) more likely to have all 5 medications prescribed at discharge compared with an NSTEMI, and 3.1 times (OR, 3.1, 95% CI, 2.6-3.7) more likely compared with unstable angina.

DISCUSSION

In this retrospective observational analysis of patients with ACS in a rural integrated delivery system, we found the medication burden among this group to be high on admission and to increase significantly in number and complexity thereafter. To our knowledge, this is the first report that quantifies the total medication use burden, as a patient transitions care from hospital admission through the discharge and postdischarge process after being given a diagnosis of ACS. Specifically, we found that our patients increase the number of medications from admission to discharge and are taking a median of 11 medications daily, with 9 of every 10 patients taking at least 1 scheduled medication twice a day or more.

FIGURE 2. Medication Use From Admission to Discharge Among Index ACS Cohort 2008-2012



ACE indicates angiotensin-converting enzyme; ACS, acute coronary syndrome; ARB, angiotensin receptor blocker.

following an ACS hospitalization, with approximately doubling of the use of beta-blockers, aspirin, and statins and nearly quadrupling of $P2Y_{12}$ receptor inhibitor use from admission to discharge. Despite this, only a minority of patients received all 5 classes of medications on discharge. As this study was conducted over a period of 5 years, beginning in 2008, temporal effects may explain some of these shortcomings (eg, low use of high-intensity statins prior to 2013 due to treatment to a low-density lipoprotein cholesterol goal of <70 mg/dL versus American College of Cardiology/American Heart Association updated guidelines recommending use of high-dose, high-intensity statins independent of the cholesterol-lowering effect), but may better reflect inertia in implementing best practice guidelines within this population.

Although we identified measurable increases in the usage of cardioprotective medications during hospitalization, little additional changes were made in the post-discharge period despite apparent gaps in recommended cardioprotective medications. These findings should help to bolster support for more inpatient initiation and adjustment of therapy to reduce these gaps prior to discharge. It should also alarm healthcare professionals that few additional changes to cardioprotective medications are made in the postdischarge period, signifying a need to provide better transitional guidance to outpatient providers and for outpatient providers to assist with recommended medication use in the postdischarge period. Best practice approaches to transitional care may include a combination of multidisciplinary care, enhanced use of health information technology, and/or focused care with pharmacists.[13,14]

Although these results confirm the high medication burden of patients being discharged following ACS diagnosis, they most likely underestimate the real medication totals and administration frequencies experienced by patients. We intentionally restricted our medication totals to traditional medications to reduce variability being introduced by usage of self-prescribed medications and potential bias introduced from patient recall and incomplete EHR capture of other nonprescribed alternative medications. The actual extent of this exclusion on our medication use is uncertain, as the use of complementary and alternative medicine varies widely, ranging in prevalence from 4% to 68%.[12] In addition, although we captured the frequency of dosing of medications, we were unable to capture the actual times of day that medications were taken; several medications may be taken just once a day, some are typically taken in the morning (eg, beta-blockers), whereas others are commonly taken in the evening (eg, statins). Therefore, only capturing how many times a day a medication is taken will not capture the daily dosing frequency burden for an individual patient. Ultimately, our study results demonstrate a high medication burden for total medications and administration frequency per day, which is likely even more complex than our analysis could accurately describe.

As anticipated, we found significant increases in the prescribing of evidence-based cardioprotective medications during and

These results provide insights into the extent of the total medication burden patients with ACS experience throughout their peri-hosptialization period and have direct implications on current practice, future research, and policy. In particular, even with our conservative estimates for total medications, patients with ACS are being discharged, on average, with over 11 medications unrestricted to the underlying reason for hospitalization—namely the ACS event. Hence, patients must coordinate new, changing, and discontinued medications in their already complex medication regimen following hospitalization. Providers should therefore be acutely sensitive to the changes being made throughout hospitalization, reconciling medications and engaging patients as they move through the peri-hospitalization period to ensure patient understanding of the modifications and coordination of medications post discharge.

Although not directly measured in this study, medication adherence is a major problem in patients post hospitalization for ACS[5]; both primary (first fill) and secondary medication nonadherence are large impediments to improved outcomes following ACS. Our study will help to assist providers, health systems, and policy makers in understanding the extent to which new or adjusted cardioprotective medications play a role in the overall medication burden of patients post discharge. Efforts to assist patients in the transition process prior to discharge, such as ensuring appropriate medication selection titration and follow-up, providing complete medication reconciliation, and counseling patients on adherence while paying particular attention to medication complexity, may help reduce gaps in care.

Limitations

Caution should be used in extrapolating our results to that of other healthcare systems and settings as the population (eg, predominantly white, rural population), culture, and practice at Geisinger may not necessarily reflect that of other healthcare systems. The ACS breakdown and use of cardioprotective medications within our patient cohort, however, are broadly consistent with other observational studies.[7,8,15,16] Perhaps more dissimilar was our finding of a highly comorbid population, including a high proportion of heart failure patients (24.33%). These results imply that our average patient with ACS is already highly complex. We are unclear if this was a reflection of the hospital type, high prehospitalization comorbid management, or higher prevalence rate among our index ACS population.

Our analysis is limited by the nature of EHR data and our extraction for this analysis. For pre- and postadmission data, the ability to ensure complete collection of utilization and outcome data is limited because the EHR only captures data from encounters that occur within the Geisinger network of ambulatory and inpatient facilities. For example, postdischarge follow-up that occurs at a non-Geisinger site would not be included in our analysis. Also, the definition of an index ACS event did not exclude prevalent patients from inclusion in the cohort, since a patient with prior ACS may still have an index hospitalization if they had an event prior to 2008, or were admitted to a non-Geisinger facility during the given period. Our electronic capture of PTA, in-hospital, and discharge medication lists allows for intraperson comparisons of medication-related measures, but is subject to missing information bias caused by incomplete or inaccurate capture of PTA medications. Specifically, PTA lists were composed of a combination of patient self-report and electronic medication lists derived from

TABLE 3. Cardioprotective Medication Use During ACS Peri-Hospitalization Period

	Admission N = 4767	Discharge N = 4767	Follow-up (90 days) N = 3285
Proportion prescribed aspirin	2451 (51.4%)	4318 (90.6%)	3041 (92.6%)
STEMI (1602)	603 (37.6%)	1466 (91.5%)	1090 (68.0%)
NSTEMI (2040)	1114 (54.6%)	1839 (90.2%)	1232 (60.4%)
Unstable angina (1125)	734 (65.2%)	1013 (90.0%)	719 (63.9%)
Proportion prescribed $P2Y_{12}$ receptor inhibitor	765 (16.1%)	3040 (63.78%)	2220 (67.6%)
STEMI (1602)	165 (10.3%)	1272 (79.4%)	930 (58.1%)
NSTEMI (2040)	323 (15.8%)	1182 (57.9%)	850 (41.7%)
Unstable angina (1125)	277 (24.6%)	586 (52.1%)	440 (39.1%)
Proportion prescribed statin	2489 (52.2%)	4271 (89.6%)	2977 (90.6%)
STEMI (1602)	657 (41.0%)	1464 (91.4%)	1087 (67.9%)
NSTEMI (2040)	1116 (54.7%)	1824 (89.4%)	1205 (59.1%)
Unstable angina (1125)	716 (63.6%)	983 (87.4%)	685 (60.9%)
Proportion prescribed high-dose statin (40- and 80-mg atorvastatin; 20- and 40-mg rosuvastatin)	368 (7.7%)	858 (18.0%)	708 (21.5%)
STEMI (1602)	83 (5.2%)	304 (19.0%)	268 (16.7%)
NSTEMI (2040)	168 (8.2%)	353 (17.3%)	273 (13.4%)
Unstable angina (1125)	117 (10.4%)	201 (17.9%)	167 (14.8%)
Proportion prescribed beta-blocker	2298 (48.1%)	4255 (89.3%)	2953 (89.9%)
STEMI (1602)	574 (35.8%)	1470 (91.8%)	1076 (67.2%)
NSTEMI (2040)	1073 (52.6%)	1842 (90.3%)	1220 (59.8%)
Unstable angina (1125)	645 (57.3%)	943 (83.8%)	657 (58.4%)
Proportion prescribed ACE inhibitor or ARB	2102 (44.1%)	2707 (56.8%)	2001 (60.9%)
STEMI (1602)	553 (34.5%)	1005 (62.7%)	764 (47.7%)
NSTEMI (2040)	989 (48.5%)	1115 (54.7%)	791(38.8%)
Unstable angina (1125)	560 (49.8%)	587 (52.2%)	446 (39.6%)
Proportion on all 5 classes of ACS medications (any dose statin, ACE inhibitor/ARB, beta-blocker, aspirin, $P2Y_{12}$ receptor inhibitor)	215 (4.5%)	1662 (34.9%)	1244 (37.9%)
STEMI (1602)	44 (2.8%)	780 (48.7%)	569 (35.51%)
NSTEMI (2040)	88 (4.3%)	618 (30.3%)	465 (22.79%)
Unstable angina (1125)	83 (7.4%)	264 (23.5%)	210 (18.67%)

ACE indicates angiotensin-converting enzyme; ACS, acute coronary syndrome; ARB, angiotensin II receptor blocker; NSTEMI, non-ST-segment elevated myocardial infarction; STEMI, ST-segment elevated myocardial infarction.

orders placed in the EHR, whereas the discharge assessments relied on medication lists alone. Missing, incomplete, or outdated medication lists could have affected the comparisons of preadmission and discharge medications. For example, we assumed that the small numbers of patients with no PTA or EHR medications were not taking any medications on admission. However, it is possible that some patients were on medications but did not report this information when presenting at the hospital, resulting in underestimation of PTA medication use.

CONCLUSIONS

The burden of medication use from hospital admission to discharge among patients with ACS is complex and increases throughout the peri-hospitalization period. Cardioprotective medication use, even in an integrated delivery system, can be improved. Efforts to increase evidenced-based medication use and assist patients with complex medication regimens prior to and after discharge could improve care among this population. ■

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Authorship Information: Concept and design (EAW, SRS, JBJ, DC, DB, XY); acquisition of data (SRS); analysis and interpretation of data (EAW, SRS, JBJ, DC, PB, DB, XY, RVL, GF); drafting of the manuscript (EAW, SRS, JBJ, DC, PB, DB, GF, XY); critical revision of the manuscript for important intellectual content (EAW, SRS, JBJ, RVL, DC, DB); statistical analysis (PB, XY); obtaining funding (EAW, SS, DC, DB, JBJ); administrative, technical, or logistic support (RVL, JBJ, DC, DB, GF); and supervision (EAW).

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