



Original article

Pharmacist role to enhance the prescribing of hospital discharge medications for patients after heart attack

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ABSTRACT

Objectives: This study aimed to explore the cardiologist adherence with ACC/AHA guidelines on discharge medications for patients admitted with acute coronary syndrome (ACS), assess the predictors of cardiologist non-adherence and measure the impact of pharmacist intervention on improving guideline adherence.

Methods: The study included two consecutive phases: observation and intervention. It was carried out at Al-Najaf Center for Cardiac Surgery and Catheterization, Iraq, from August through December 2018. In the observation phase, medical records were reviewed retrospectively in order to assess the adherence to guideline. The intervention phase was performed prospectively by the clinical pharmacist, who conducted interventions including auditing, feedback and discussion with every prescriber. The reference of the recommendations was the guideline of American Heart Association/American College of Cardiology guideline (AHA/ACC). The primary outcome was the proportion of patients discharged with optimal treatment. Independent T-test was used to measure the difference in the means of age between the two patient groups. For categorical variables (gender, diagnosis, and comorbidities), chi-square test was used. Binary logistic regression was used to identify patient and disease characteristics associated with receiving optimal discharge regimen.

Results: The observation phase included 100 patients with ACS, while the intervention phase included 105 patients. A total of 50 interventions were performed by pharmacist, of which adding necessary medication was the most frequent (88%), followed by dose optimization (10%), and removing medication duplication (2%). Seventy-four percent of the provided recommendations were accepted by the cardiologists. Pharmacist intervention caused significant (P -value < 0.05) improvement (increasing) in the prescribing of β -blockers, ACE inhibitors/ARBs, statins, and the proportion of patients who received all optimal five therapies (from 35% in observation phase to 80% after intervention).

Conclusion: This study showed that pharmacist intervention had a considerable positive impact on the cardiologist prescribing pattern of the essential discharge medications for patients with ACS which could improve patient clinical outcomes.

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1. Introduction

Cardiovascular diseases (CVD) are among the major causes of death worldwide. In 2016, it was reported that 17.9 million deaths were caused by CVD accounting for 31% of all worldwide deaths. Acute coronary syndrome (ACS) and stroke were responsible for 85% of these deaths (World Health Organization, 2017). ACS describes the range of clinical presentations that involve unstable angina or acute myocardial infarction (AMI) which is also subdivided into ST segment elevation myocardial infarction (STEMI) or

non-ST segment myocardial infarction (NSTEMI) (Amsterdam et al., 2014).

Patients who experience ACS are at high risk of recurrent cardiovascular events in the future. Approximately 20% of patients with ACS are readmitted within 30 days of hospital discharge (Krumholz et al., 2009). Thus, a number of preventive medications need to be administered to ACS survivors to prevent recurrent events, decrease mortality, and improve survival and quality of life (Lazar, 2005; Raposeiras-Roubín et al., 2014; Zhong et al., 2017; Brown and Austin, 2017). Guidelines for managing ACS have been produced by the American College of Cardiology (ACC)/ American Heart Association (AHA) since 1980. These guidelines are reviewed annually and updated as necessary (Amsterdam et al., 2014). Implementation of the guideline recommendations helps to decrease the risk of cardiovascular damage and death among ACS patients (Anderson et al., 2007; O'Gara et al., 2013). It has been shown that sticking to the guideline-recommended medications is responsible for approximately half of the 72% decline in coronary heart disease related mortality (Koopman et al., 2016). These guidelines recommend that patients who have experienced an ACS should be maintained on antiplatelets, β -blockers, Angiotensin Converting Enzyme (ACE) inhibitors or Angiotensin Receptor Blockers (ARBs), and statins unless there is drug contraindication (Smith et al., 2011).

Despite these guideline recommendations, a large gap between prescribed and indicated therapy can be observed globally, with suboptimal use of preventive medications (Yusuf et al., 2011; Sheikh-Taha and Hijazi, 2014; Bansilal et al., 2015). This prescribing gap could be attributed to contraindications to medications, errors of omission, unexplained non-adherence (Wilkins et al., 2017), physicians' concern for potential adverse effects (Al-Zakwani et al., 2011), lack of active interventions (Hassan et al., 2013), physicians' avoidance of polypharmacy, and insufficient drug information (Aneena et al., 2016). In Iraq, ischemic heart disease (IHD) is the second leading cause of mortality (Institute for Health Metrics and Evaluation., 2018). According to the last World Health Organization (WHO) report (2018), 32,582 (18.50%) of total annual deaths in Iraq are due to coronary heart disease (CHD). Iraq ranks 19th among the top 25 Middle Eastern countries with the highest CHD mortality (World Life Expectancy, 2018). Among the highly promising approaches to enhance providers' prescribing practices are pharmacist-led interventions (Grindrod et al., 2006). The study objectives were to explore the cardiologist adherence with ACC/AHA guidelines on discharge medications for patients admitted with ACS, assess the predictors of cardiologist non-adherence and measure the impact of pharmacist-mediated interventions on adherence to the guideline of discharge medications.

2. Methods

Study settings: The study was conducted at one public cardiac center (Al-Najaf Center for Cardiac Surgery and Catheterization, Al-Sader Medical City) in Al-Najaf, Iraq during the period from August through December 2018. This study included patients with acute presentation of all types of ACS (unstable angina, STEMI = ST Segment Elevation Myocardial Infarction, NSTEMI = Non-ST Segment Elevation Myocardial Infarction) and who were admitted receiving percutaneous coronary intervention (PCI). Exclusion criteria included medical records with missing information of discharge medications, missing precise diagnosis, unclear handwriting, and incomplete patient information. Patients admitted with conditions other than ACS were also excluded.

Study design: The study involved two consecutive phases: observation (retrospective) and intervention (prospective). The observation phase was conducted over two months period (August

and September 2018) and then the intervention phase was conducted over the next two months (November and December 2018). The number of recruited patients relied on the number of eligible cases can be reviewed within the specific timeline for each phase (two months). The observation phase was performed retrospectively by reviewing the medical records of patients diagnosed with ACS. That was to assess the cardiologist adherence to the ACC/AHA guideline of ACS treatment (Appendix A). A data extraction sheet was created to collect information from patients' medical records including patient demographics, clinical presentation, medical history, diagnosis and discharge medications. This review focused on whether the patients received the optimal discharge prescription of five medications including dual antiplatelets (Aspirin and clopidogrel), statin, ACE inhibitor or ARB, and β blocker. Both phases included medical record reviewing, but for two different cohorts of patients. The observation phase was retrospective reviewing, while intervention phase was prospective.

The clinical pharmacist started the prospective intervention after analyzing the observation phase data. The clinical pharmacist had partial affiliation with the cardiac center and was part of the research team. In the intervention phase, the clinical pharmacist reviewed the medical records of patients to evaluate their discharge medications and to determine whether pharmacist intervention is needed to improve the prescriber adherence to the guideline. Patients' demographics, clinical presentation, medical history, medications prescribed before intervention, and reasons behind not prescribing recommended medications were reported. After that, a prospective necessary intervention was conducting by face-to face discussing with the prescriber (senior cardiologists). The primary goal of the intervention was to recommend prescribing all the desired guideline five medications to discharged patients. Thus, the intervention involved asking prescribing cardiologists to add any missing recommended five medication(s) (one or more) unless contraindicated and correcting suboptimal doses. The recommendations were based on ACC/AHA guidelines (Amsterdam et al., 2014; O'Gara et al., 2013). Additionally, pharmacist intervention(s) and physicians' response to the pharmacist intervention were also reported (as acceptance or rejection). The primary outcome was proportion of patients discharged with optimal secondary prevention medications consisting of dual antiplatelets, statin, ACE inhibitor or ARB, and β blocker.

This study was approved by the Scientific Committee of Researches of Al-Najaf Health Directorate (Ref# 2018-684), as well as by the Ethics and Scientific Committee of Faculty of Pharmacy/ University of Kufa (Ref# 2018-199).

2.1. Statistical analysis

Statistical analysis was conducted using the statistical package for social sciences (SPSS) version 25 software for Windows. Descriptive statistics are presented as frequencies, percentages, mean, and standard error mean. Independent two samples student's T-test was used to measure the difference between the means of normally distributed continuous variables (age of the two groups). For categorical variables, chi-square test and Fisher's exact test (when chi-square couldn't be applied) were used (gender, diagnosis, and comorbidities). Binary logistic regression was used to identify the patient and disease characteristics (independent variables) associated with receiving optimal discharge regimen (outcome variable). The outcome variable was binary (received optimum vs not-optimum discharge therapy) and the logistic regression analysis was conducted for the observation phase data. The Odds ratio (OR) and 95% confidence interval (CI) were calculated. P-value < 0.05 was considered statistically significant.

3. Results

The observation phase involved 100 records of patient with ACS, while the intervention phase included 105 patients. There were no statistically significant differences (P -value > 0.05) between the patients in observation and intervention groups in terms of age, gender, diagnosis or comorbidities (Table 1).

The secondary prevention medications prescribed to patients with ACS in both observation and intervention phases are shown in Fig. 1. In the observation phase, all patients received aspirin, 98% of patients received Clopidogrel/ ticagrelor, 77% β -blockers, 49% ACE-inhibitors/ARBs and 95% received statins, however, 35% of patients received all of five classes of medications (see Fig. 1).

The pharmacist intervention significantly (P -value < 0.05) increased the proportion of patients who received the optimal prevention regimen on discharge from 35% in the observation phase to 80% in the intervention phase (Fig. 1). The improvements particularly included receiving ACE-Inhibitors/ARBs, β -blockers and statins. Despite the prescribing rate of antiplatelets reaching 100%, no statistical impact was noticed (P -value > 0.05). Interestingly, 80% of patients in the intervention group received optimal guideline recommended therapy compared to only 35% of patients in observation phase and this difference was statistically significant (P -value < 0.05).

Among the 95 patients who received statin in the observation phase, 81 (85.3%) received high intensity statin (as recommended by the guideline), while 14 (14.7%) received moderate dose (not recommended). Compared to the observation phase, the tendency toward prescribing high intensity statins (either atorvastatin (40–80 mg) or rosuvastatin (20–40 mg)) in the intervention group was significantly higher (P -value < 0.05) (Table 2). In the intervention phase, 93.3% ($N = 98$) of cases received high intensity statins, while only 6.7% ($N = 7$) received moderate intensity statins.

The main objective of binary logistic regression analysis was to predict the likelihood of non-adherence to recommended guideline therapy based on patient and disease characteristics. Binary logistic regression showed two predictors have significant (P -value < 0.05) negative ($OR < 1$) relationships with receiving optimal discharge regimen. Female patients are less likely (95% CI, 0.06 – 0.85) to receive optimal discharge medications. Those with polypharmacy (receiving more than five medications) were also less likely (95% CI, 0.004 – 0.34) to receive the optimal discharge regimen (Table 3).

In the observation phase, we reviewed the medical records of 100 patients diagnosed with ACS. Of them, 35 patients (35%) were discharged with optimal secondary prevention medication. The remaining 65 patients were discharged with suboptimal medica-

tions. Reviewing medical records identified 105 potential drug-related prescribing problems. Those medication-related problems included 81 incidents when medications were indicated, but not prescribed, 19 problems were related to prescribe incorrect doses, and five problems were related to drug interactions (Table 4). The indicated, but not prescribed medications included ACE inhibitors/ARBs (51/81, 62.9%), β -blocker (23/81, 28.4%), statins (5/81, 6.2%), and clopidogrel/ticagrelor (2, 2.5%) (Fig. 2). In contrast, the pharmacist intervention reduced the number of potential prescribing problems from 62 to 25 after addressing five prescribing wrong doses and one drug-drug interaction in addition to initiating 31 indicated discharge medications (Table 5).

The pharmacist asked the prescribers (physicians) about the reason behind not prescribing the medications. The reasons behind non-prescribing some preventive medications for patients with ACS included omission (53.6%), contraindications (21.4%), concern of adverse effects (21.4%) and other reasons (3.6%), which included insufficient drug information and unexplained non-adherence (Table 6).

The clinical pharmacist provided 50 recommendations to prescribers including adding necessarily medication (88%), optimizing drug doses (10%), and removing medication duplication (2%). Regarding the acceptance of implementation of the pharmacist recommendations, 74% had been accepted while 26% were rejected. Regarding medication initiation, the majority of accepted recommendations were those concerning ACE-inhibitors/ARBs (51.6%), followed by those with β -blocker (29%), and statins (19.4%) (Table 6).

As a case example of the pharmacist-induced intervention, the pharmacist resolved the misunderstanding of physicians about the adverse effects of these drugs. For example, some cardiologists did not prescribe ACE inhibitor/ ARB for normotensive patients. The pharmacist highlighted the fact that these drugs should be prescribed for patients with ACS even in case of normotensive because they improve survival, decrease cardiac remodeling, and decrease readmission rate. In case of β blockers, the pharmacist recommended that these drugs should be prescribed in a low dose and titrated to the maximum tolerated dose to avoid the risk of bradycardia.

4. Discussion

Optimal secondary prevention therapy is the gold standard for reducing cardiovascular mortality and readmission following ACS (Zhong et al., 2017). However, under-prescribing of the guideline recommended medications still exist worldwide (Yusuf et al., 2011; Sheikh-Taha and Hijazi, 2014; Bansilal et al., 2015). Pharma-

Table 1
Baseline Patients' demographics and clinical characteristics.

| Demographic Characteristics | Observation group (N = 100) | Intervention group (N = 105) | P-value |
|-----------------------------|-----------------------------|------------------------------|---------|
| Age (years) | 58 \pm 1.07 | 57 \pm 0.95 | 0.559 |
| Gender | | | |
| Male | 77 (77) | 69 (65.7) | 0.074 |
| Female | 23 (23) | 36 (34.3) | |
| Diagnosis | | | |
| Unstable Angina | 55 (55) | 59 (56.2) | 0.933 |
| STEMI | 37 (37) | 39 (37.1) | |
| NSTEMI | 8 (8) | 7 (6.7) | |
| Comorbidities No. (%) | | | |
| DM | 35 (35) | 44 (41.9) | 0.31 |
| HTN | 68 (72) | 58 (55.2) | 0.061 |
| CAD | 16 (16) | 13 (12.4) | 0.475 |
| Others* | 2 (2) | 1 (0.9) | 0.614 |

STEMI = ST Segment Elevation Myocardial Infarction; NSTEMI = Non-ST Segment Elevation Myocardial Infarction; DM = diabetes mellitus; HTN = hypertension; CAD = Coronary artery disease; CKD = chronic kidney disease. Data is expressed as mean \pm SEM, frequencies, and percentages. T-test and Chi-Square/ Fisher's exact tests were used to analyze data, ($P < 0.05$).

* Others: asthma and CKD.

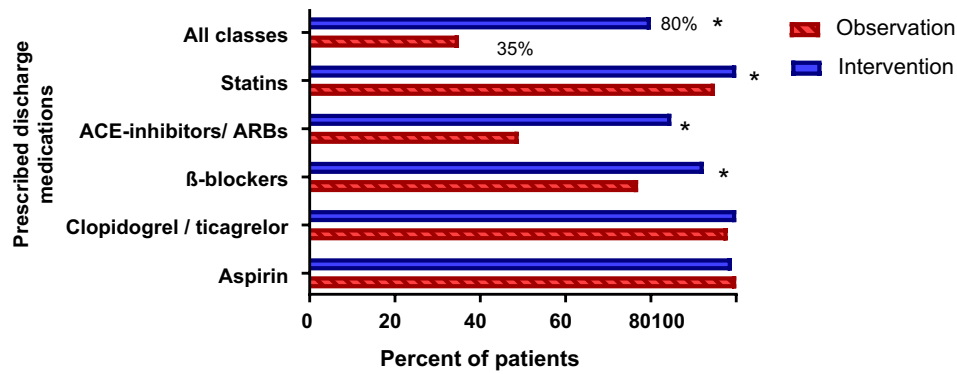


Fig. 1. The percent of patients on optimal discharge medications in observation and intervention phases. We have 2 different denominators for the figure % (100 for observation phase and 105 for intervention phase). *Significant difference ($P < 0.05$) according to Chi-Square test.

Table 2
The proportion of patients received high and moderate doses of statins.

| Dose of statin | Control group (n = 95) No. (%) | Intervention group (n = 105) No. (%) | p-value |
|----------------|--------------------------------------|--|---------|
| High dose* | 81 (85.3) | 98 (93.3) | 0.063 |
| Moderate dose | 14 (14.7) | 7 (6.7) | |

Chi-Square was used, ($P < 0.05$).

* High dose is the guideline recommended dose, while moderate dose is not recommended.

Table 3
Binary logistic regression for predictors of adherence to the guideline in the observation phase.

| Variables | Odds ratio | 95% CI | P value |
|--------------------------------|------------|--------------|---------|
| Age ≥ 65 years | 1.087 | 0.34–3.48 | 0.888 |
| Gender (Female vs Male) | 0.220 | 0.06–0.85 | 0.028* |
| STEMI | 0.827 | 0.13–5.33 | 0.841 |
| NSTEMI | 0.846 | 0.12–5.76 | 0.865 |
| Hypertension | 1.676 | 0.18–15.26 | 0.647 |
| Diabetes mellitus | 0.189 | 0.01–3.32 | 0.255 |
| CAD | 1.886 | 0.29–12.29 | 0.507 |
| One comorbidity | 1.609 | 0.014–179.84 | 0.843 |
| ≥ 2 comorbidities | 0.366 | 0.03–4.04 | 0.412 |
| Taking more than 5 medications | 0.038 | 0.004–0.34 | 0.003* |

Outcome variable = receiving optimal discharge medications ((Aspirin and clopidogrel), statin, ACE-inhibitor or ARB, and β -blocker).

* Significant ($P < 0.05$). Female patients and those with polypharmacy are less likely to receive optimal discharge medications. STEMI = ST Segment Elevation Myocardial Infarction; NSTEMI = Non-ST Segment Elevation Myocardial Infarction; CAD = Coronary artery disease.

Table 4
The frequency of potential prescribing-related problems in observation and intervention phases.

| Medication related problem | Observation Phase | After Intervention |
|------------------------------------|-------------------|--------------------|
| Drug indicated but not prescribed* | 81 | 25 |
| Wrong dose | 19 | 0 |
| Drug-drug interaction | 5 | 0 |
| Total | 105 | 25 |

* The pharmacist did not recommend adding contraindicated drugs in 12 cases of drug indicated, but not prescribed.

cists' knowledge about the optimal pharmacotherapy of ACS makes them able to affect doctors' prescribing pattern leading to successful guideline implementation (Hassan et al., 2013). To the best of our knowledge, the current study was the first one conducted in Iraqi

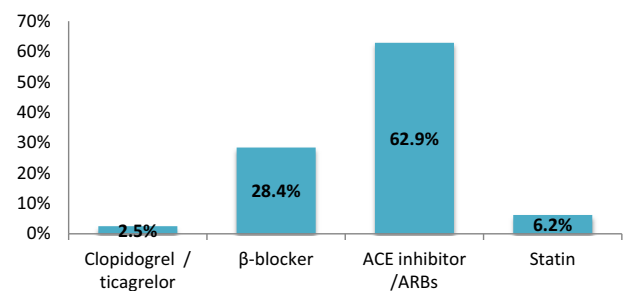


Fig. 2. Types and percentages of the medications indicated but not prescribed in observation phase.

Table 5
Reasons behind not-prescribing preventive medications in intervention phase.

| Reason | No. | % |
|----------------------------|-----|------|
| Omission‡ | 30 | 53.6 |
| Contraindications* | 12 | 21.4 |
| Concern of adverse effects | 12 | 21.4 |
| Others* | 2 | 3.6 |
| Total | 56 | 100 |

Note: We could not obtain similar information for the observation phase because it was reviewed retrospectively. ‡ Omission = forgetfulness. * Examples of contraindications to beta blockers include unstable heart failure, and bradycardia. Example of contraindications to ACE inhibitors/ARBs include hypotension and renal impairment. The source of this table was the cardiologists.

* Others: Insufficient drug information and unexplained non-adherence.

Table 6
Types of pharmacist recommendations to cardiologists.

| Pharmacist intervention | Recommendations provided N (%) | Recommendations accepted N (%) | Acceptance rate % |
|-------------------------------|-----------------------------------|-----------------------------------|-------------------|
| β-blocker | 12 (27.3) | 9 (29.0) | |
| ACE inhibitor/ARB | 26 (59.1) | 16 (51.6) | |
| Statin initiation | 6 (13.6) | 6 (19.4) | |
| Total drug initiations | 44 (88) | 31 (77.5) | 70.5 |
| Dose optimization | 5 (10) | 5 (12.5) | 100.0 |
| Remove medication duplication | 1 (2) | 1 (2.5) | 100.0 |
| Total interventions | 50 | 37 | 74 |

cardiac centers that tried to assess the impact of pharmacist intervention on improving prescribing practice in the setting of secondary prevention of ACS.

The chart extraction in the observation phase indicated under-prescription of the essential secondary prevention medications. In other words, only 35% of ACS patients were discharged with optimal regimen. Similarly, a study in six Arab Gulf Countries found that the prescription rate for evidence-based discharge medications was only 49% (Al-Zakwani et al., 2011). In Lebanon, a multi-center study found that 40% of ACS patients were discharged with optimal secondary prevention medications (Safwan et al., 2017).

In terms of medications, ACE inhibitors/ARBs, β -blockers, and statins were prescribed sub-optimally where 49% of ACS patients received ACE inhibitors/ARBs and 77% received β -blockers in the observation phase. These findings tie in well with those reported by previous studies which also revealed suboptimal prescribing of ACE inhibitors/ARBs and β -blockers (Al-Zakwani et al., 2011; Safwan et al., 2017). On the other hand, statins were prescribed to 95% of patients in the current study which is higher than that found in the previous studies (Al-Zakwani et al., 2011; Safwan et al., 2017) (Fig. 1).

The suboptimal prescription of these life-saving medications is not merely observed in developing countries, but also in developed countries as revealed by several previous studies in United States (50%) and Europe (46.2% in Germany and 69.1% in Netherland) (Gill et al., 2017; Bramlage et al., 2010; Tra et al., 2015). It is important to note that this variation in guideline adherence does not always mean that patients are not managed optimally (Safwan et al., 2017) (See Table 5). The guidelines recommend prescribing all these medications in case of there is no contraindication (9, 2). In the present study, under-prescribing may be due to presence of contraindications (Table 4). This finding is in line with a previous study which found that under-prescribing following pharmacist intervention was largely because of contraindications to prescribing (Wilkins et al., 2017). Consequently, the pharmacist did not recommend adding contraindicated drugs in 12 cases of drug indicated, but not prescribed (Table 5).

However, the prevalence of these contraindications does not justify this dramatic non-adherence to the guideline. In fact, some causes were non-justifiable including improper prescribing due to error of forgetfulness and concerning about adverse drug reactions. Other reasons included physicians' worry about potential adverse effects and physicians' avoidance of polypharmacy (Aneena et al., 2016).

Similarly, a previous study showed that contraindication to prescribing was the most frequent reason behind not prescribing of β -blockers and aspirin (Sabouret et al., 2010). Moreover, lack of pharmacist interventions to assure guideline implementation is another potential cause of suboptimal prescribing of these life-saving medications (Hassan et al., 2013). In summary, we can classify the reasons of not prescribing all five recommended medications into justifiable (drug contraindication) and non-justifiable (forgetfulness).

Another important finding was that ACE inhibitor was the most frequently indicated, but not prescribed drug class. This finding is in accordance with a previous study result (Tra et al., 2015). The suboptimal prescribing may be due to the presence of contraindications to ACE inhibitors, error of omission, unexplained non-adherence to the guideline, or physicians' concern about adverse effects of ACE inhibitors (Wilkins et al., 2017).

Although there was a trend toward prescribing high intensity statin in this study, it did not match the optimal discharge guideline that recommends almost all patients should receive high statin dose. This prescribing pattern is reflected by 85.3% of patients received high statin doses compared to only 14.7% received moderate doses. This finding is consistent with a former study report where 88.7% and 7.7% of patients received high and moderate dose statin respectively (Aneena et al., 2016). This may be explained by

the awareness about the beneficial effect of high dose statin for management of ACS. It has been shown that treatment with high intensity statin considerably reduces the risk of recurrent MI, stroke, hospital readmission, and need for revascularization (Zhong et al., 2017; Murphy et al., 2009).

The logistic regression has shown that optimal discharge treatment was less likely to be prescribed for female patients. Several previous studies revealed agreement with this finding (Al-Zakwani et al., 2011; Tra et al., 2015; Yan et al., 2007; Wai et al., 2012). Since women have less risk factor for cardiovascular disease than men, this could affect the physician prescribing of discharge therapy. Another finding of the regression analysis was that patients who had more than five drugs (polypharmacy) were more likely to be discharged with suboptimal discharge medications (Table 3). The underuse of optimal therapy for patients with polypharmacy could be explained by physicians' concern of adding more drugs for such patients in order to avoid the potential adverse effects of the added medications.

After reviewing each discharge prescription, the clinical pharmacist went to inform the senior cardiologist who prescribed the discharge regimen and request the required preventive five medications since the attending physicians have no authority to change the discharge regimen. The intervention phase demonstrated that pharmacist intervention via review, feedback, and discussions with prescribers made a considerable improvement in the prescribing of secondary prevention medications. As evidenced by the findings, 80% of patients discharged with optimal treatment in the intervention group compared to only 35% in the observation group (Fig. 1). Additionally, the prescribing rates of β -blockers, ACE-inhibitors and statins were significantly higher in intervention group compared to the observation group. On the other hand, although it was not significant increment, the proportion of patients who received antiplatelets was higher in the intervention group (Fig. 1). Similarly, a Malaysian interventional study showed that pharmacist intervention including guideline reminders, audit, feedback, and face to face discussion with prescriber caused significant enhancement in prescribing of β -blockers, ACE-inhibitors/ARBs and statins with no significant effect on antiplatelet prescribing. Overall, the intervention caused increment in proportion of patients who received all five medications (from 42.6% to 62.6%, P -value = 0.001) (Hassan et al., 2013).

Comparable findings were demonstrated by an interventional cohort study in New Zealand that involved the use of a pre-discharge checklist to improve guideline adherence. This intervention resulted in significant (P -value < 0.05) improvement in the prescribing of all five discharge medications (Aspirin, Statin, ACE-I, β -blocker and Adenosine diphosphate (ADP) receptor antagonist) (Wilkins et al., 2017). Furthermore, an American study showed that pharmacist interventional program with guideline reminders and contact with physicians notably enhances the discharge prescribing of aspirin, β -blockers, and ACE-inhibitors (Axtell et al., 2001). Finally, a recent Iraqi study found that hospital pharmacist-led intervention enhanced post-operative intravenous fluid prescribing and minimized fluid-related complications (Abbood et al., 2019).

It is important to note that, the improvement in the prescribing pattern in the current study was attributed to the acceptance of pharmacist-initiated interventions. In fact, 74% of the provided recommendations were accepted by physicians. In contrast, a previous Iraqi study about general prescribing medication errors shows that physicians only implemented one-third of hospital pharmacist recommendations (Al Jumaili et al., 2016).

Few limitations about this study must be taken into consideration. Firstly, the study was conducted in a single cardiac center. Secondly, because the observation phase data collection was conducted retrospectively from patients' medical records, the real rea-

sons of not prescribing the optimal prevention regimen were not confirmed. Thus, the availability of full documentation of discharge medications may be a limitation in the observation phase. Finally, no assessment of cost or sustainability of intervention was looked at. Assessing the impact of pharmacist intervention on patient clinical outcome measures and readmissions can be done in a future work.

5. Conclusions

The current study revealed that the secondary prevention medications for patients with ACS were prescribed sub-optimally. ACE inhibitors/ ARBs were the least prescribed drug classes for the discharged patients. Patients receiving more than five medications were less likely to receive the optimal discharge regimen. The study also showed that pharmacist intervention via record review, feedback, and discussions with prescribers considerably improved the prescribing pattern of these essential discharge medications. Iraqi cardiologists need to follow the guideline in prescribing discharge regimen to avoid early readmission and enhance patient clinical outcome.

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No funding was provided

Declaration of Competing Interest

No conflict of interest.

Appendix A. Summary of AHA/ACC guideline for the Management of patients with ST-Elevation and Non-ST-Elevation acute coronary Syndromes.

- LOE = level of evidence: Level A > level B.
- Level A: Data derived from multiple randomized clinical trials (RCT) or meta-analyses. Level B: Data derived from a single RCT or non-randomized clinical studies.
- Class I: Benefit \ggg Risk;
- Class IIa: Benefit \gg Risk (additional studies with focused objectives needed).

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2. Patrick O'Gara, Frederick Kushner, Deborah Ascheim, et al. 2013 ACCF/AHA Guideline for the Management of ST-Elevation Myocardial Infarction. Vol. 61, No. 4, 2013.

| Medication | Recommendations | Level of evidence | Class of recommendation |
|---------------------|---|----------------------|-------------------------|
| Aspirin | Patients with ACS should receive indefinite treatment of aspirin in absence of contraindication. | A | I |
| Clopidogrel | Along with aspirin, clopidogrel must be administered for at least 1 year for ACS patients who are undergoing PCI as well as those managed medically. | A | I |
| Beta Blocker | Indicated for all patients with ACS unless contraindicated. Beta blockers should be continued indefinitely for ACS patients with EF \leq 40% β -blocker therapy must be continued for at least 3 years in patients with normal systolic function | A B | I IIa |
| ACE-I/ ARBs | ACE inhibitor should be started on first day and continued indefinitely provided there is no contraindication. If there is intolerance, then ARB is a suitable alternative | A | I |
| Statins | Unless contraindicated, high intensity statin therapy (either atorvastatin \geq 40 mg or rosuvastatin \geq 20 mg) is recommended for all post ACS patients to obtain LDL cholesterol $<$ 100 mg/dL. For patients who cannot tolerate high dose of statin or those who are older than 75 years, lower doses may be prescribed. | A | I |

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