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Impact of Clinical Pharmacists-driven Bundled Activities from Admission to Discharge on 90-day Hospital Readmissions and Emergency Department Visits

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ABSTRACT

Objectives: Patient-centered clinical pharmacists' activities play a major role in improving clinical outcomes by optimizing the efficacy of drug therapies and minimizing associated toxicities during hospitalization, at the transition of care, and upon discharge. We aimed to compare the impact of comprehensive versus partial clinical pharmacists-driven bundled of care services on the rate of 90-day hospital readmissions and emergency department (ED) visits. ***Methods***: This retrospective study included all admitted patients who received a comprehensive or partial bundle of clinical pharmacy services (medication history, interventions, counseling, and discharge prescription review) from 1 January 2021 to 30 June 2021 at Sultan Qaboos University Hospital. The comprehensive bundle of care included the four services, while the partial bundle of care included one, two, or three services only. Analyses were performed using univariate and multivariate statistical techniques. ***Results:*** The study included 430 patients with a mean age of 56.0±21.0 years, and 43.7% (n = 188) were male. Of the patients, 12.1% (n = 52) received a comprehensive bundle of care. Compared with the partial bundle of care group, the comprehensive bundle of care group had significantly more patients with diabetes (65.4% vs. 42.9%; $p = 0.002$), ≥ 3 comorbidities (50.0% vs. 29.4%; $p = 0.003$), and polypharmacy (≥ 5 medications) (73.1% vs. 46.0%; $p < 0.001$). The comprehensive bundle of care group was significantly associated with a lower 90-day readmission rate (adjusted odds ratio (aOR) = 0.27, 95% CI: 0.90–0.82; $p = 0.021$) but not with ED visits (aOR = 0.57, 95% CI: 0.13–2.57; $p = 0.461$). ***Conclusions:*** This study demonstrated a significant reduction in the 90-day readmission rate for patients on a comprehensive bundle of care but not ED visits. These findings emphasize the importance of the comprehensive services provided by clinical pharmacists on the healthcare resources use and clinical outcomes.

Hospital readmissions place a significant burden on patients and healthcare systems.[1] In most cases, unplanned readmissions indicate poor health outcomes, due to the provision of inferior patient care.[2,3] In 2010, the Medicare Payment Advisory Commission in the USA, estimated that about USD 17 billion from the Medicare budget alone were related to avoidable hospital readmissions.[4] Given the health concerns and the economic burden associated with hospital readmissions, implementing evidence-based measures has become crucial worldwide.[5–7] The transition of care between hospitals and/or discharge post-admission is of particular concern as it may result in hospital readmissions or emergency department (ED) visits. Other factors associated with hospital readmission include old age, increased comorbidities, chronic diseases, polypharmacy, and adverse drug events.[8–11] Clinical pharmacy is a continually expanding and evolving profession. In the early 1990s, Hepler and Strand introduced the term 'pharmaceutical care' and defined it as the collaborative process between clinical pharmacists, healthcare teams, and patients to design, implement, and monitor therapeutic plans to achieve specific outcomes that can improve patients' quality of life.[12,13] Numerous published studies have demonstrated the effect of specific patient-centered clinical pharmacists' activities on reducing hospital readmissions and ED visits, particularly, when such activities are provided

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as a bundle of care.[8,14–21] However, due to the diverse range of pharmaceutical care services implemented in different healthcare settings, standardizing the quality of the clinical pharmacy profession poses challenges.[15,22,23]

Despite the documented impact of patient-centered clinical pharmacist activities on reducing hospital readmissions and ED visits, many hospitals do not implement these services as a bundled care.[15,22,23] One possible explanation for this is the lack of comparative studies examining the effect of all combined (bundled) services versus an individual or a combination of these services on hospital readmission and ED visits. Therefore, it is crucial to evaluate and compare the comprehensive and partial direct patient care bundles provided by clinical pharmacists in terms of their impact on the rate of hospital readmissions and ED visits within 90 days after hospital discharge. This study aimed to address this gap by examining a tertiary hospital setting in Oman.

METHODS

Sultan Qaboos University Hospital (SQUH) is a tertiary care teaching hospital with a bed capacity of around 500, offering a wide range of specialized services for patients across various age groups, from pediatrics to geriatrics. At SQUH, clinical pharmacists play a crucial role in delivering patient-centered pharmaceutical care activities, which have demonstrated their clinical significance in improving overall health outcomes and reducing costs when provided to hospitalized patients.[24,25]

These activities encompass several key components:

1. Medication history documentation upon admission.
2. Pharmaceutical interventions during the hospital stay, such as medication reconciliation, participation in multidisciplinary clinical rounds/meetings, and the development of pharmaceutical care plans.
3. Patient medication counseling throughout the hospitalization period and upon discharge.
4. Review of discharge prescriptions.

Clinical pharmacists diligently record the execution of these activities in specific forms, which are easily accessible in the electronic patients' records [Appendix 1 to 3]

We conducted a retrospective observational study from 1 January 2021 to 30 June 2021. The study included all patients admitted to SQUH who received a medication history upon admission from clinical pharmacists. Patients were categorized into two groups based on the level of care received: comprehensive bundle of care group and partial bundle of care group. Patients who did not receive a medication history on admission, were admitted to the daycare unit, or readmitted to the hospital for a scheduled admission were excluded from the study.

We collected various patient information, including demographics (age and gender), comorbidities, total number of prescribed medications, reason for admission, and types of clinical pharmacist activities received during hospitalization. These activities encompassed pharmaceutical interventions, discharge medication review, and patient counseling. We also recorded the length of hospital stay (LOS), 90-day hospital readmissions, 90-day ED visits, and reasons for readmissions and ED visits.

The comprehensive bundle of care included all components of clinical pharmacist activities, in addition to medication history on admission (H). These components consisted of pharmaceutical interventions made during the patients' hospital stay only (I), discharge medication review (D), and patient counseling during the hospital stay or upon discharge (C). In summary, the comprehensive bundle of care comprised four activities (H+I+D+C).

The partial bundle of care included at least medication history on admission (H), either with or without one or two components of clinical pharmacist activities. However, it did not include all four activities together. The partial bundle of care, in short, consisted of one, two, or three activities (H, H+I, H+D, H+C, H+I+D, H+I+C, or H+D+C).

The pharmaceutical interventions conducted by clinical pharmacists encompassed various aspects. These interventions addressed prescribing issues such as dose, frequency, duration, route, availability, therapeutic duplication, formulation, addition, deletion, restricted/reserved medications, contraindications, and restarting or withholding medications. They also involved monitoring and follow-up activities, such as requesting therapeutic drug monitoring, following up on therapeutic drug monitoring results, ordering lab tests, and managing

adverse drug reactions. Additionally, interventions related to the timing of medication administration, combination therapy, medication omission, order expiry, double ordering, medication selection, and drug interactions were included. Clinical pharmacists typically identify these intervention opportunities during a patient's hospital stay through direct communication with prescribers or during interprofessional clinical team rounds' discussions.[24,25]

Hospital readmission was classified as unplanned if it occurred within 90 days post-discharge due to an acute event requiring hospitalization. These events could be attributed to disease progression or drug-related problems. For example, if a patient was readmitted due to decompensated heart failure exacerbation triggered by infections, it would be considered as disease progression. On the other hand, if the readmission was caused by decompensated heart failure resulting from non-compliance with medications, it would be considered a drug-related problem.

Patients with three or more different comorbidities were categorized as having comorbidities ≥ 3. Polypharmacy ≥ 5 was defined as the regular use of five or more medications.

A previous study by Koehler et al,[12] observed a 28% absolute risk reduction in ED visits and hospital readmissions within 30 days by implementing a bundle of pharmaceutical care services. Based on this finding, we hypothesized that patients receiving a comprehensive bundle of care would experience an approximate 50.0% reduction in ED visits or hospital readmissions. To achieve a 95% CI with a margin error of 5%, a sample size of 377 patients was initially determined. However, to account for potential missing information and loss to follow-up, the final sample size was increased to 400 patients.

Ethical approval for the study was obtained from the Medical and Research Ethics Committee at the College of Medicine and Health Sciences, Sultan Qaboos University, Muscat, Oman (MREC #2852; SQU-EC/007/2022; dated: 10th August 2021).

Categorical variables were presented as frequencies and percentages, and differences among groups were analyzed using Pearson's chi-square test (or Fisher's exact test for expected cells < 5). Continuous variables were summarized using mean and SD for normally distributed variables or median and interquartile range for variables with an abnormal distribution. Group differences were assessed using the Student's *t*-test or Mann-Whitney U test, as appropriate. The impact of a bundle of care (comprehensive versus partial) on hospital readmissions was analyzed using multivariate logistic regression. A two-tailed level of significance was set at $p < 0.05$ level. STATA version 16.1 (StataCorp, 2013, Stata Statistical Software, College Station, TX, USA) was used for the analysis.

In the multivariate logistic regression analysis, we adjusted for confounding factors that could potentially influence a patient's risk of readmission. These factors included patients' clinical and demographic characteristics, as shown in Table 1. We included variables that exhibited a statistically significant difference ($p < 0.1$) between the comprehensive and partial care bundle groups.

RESULTS

A total of 430 patients met the study inclusion criteria. Of these, 378 (87.9%) received the partial bundle of care while 52 (12.1%) received the comprehensive bundle of care. Table 1 presents the demographic and clinical characteristics of the two groups. The mean age of the cohort was 56.0±21.0 years, with 43.7% (n = 188) of the patients being men. There were significantly more diabetic patients in the comprehensive bundle of care group than in the partial bundle of care group (65.4% vs. 42.9%; $p = 0.002$). Additionally, patients in the comprehensive bundle of care group were more likely to have ≥ 3 comorbidities (50.0% vs. 29.4%; $p = 0.003$) and polypharmacy (≥ 5) (73.1% vs. 46.0%; $p < 0.001$) than those in the partial bundle of care group. The median LOS was longer for patients in the comprehensive bundle of care group compared to the partial bundle of care group (seven vs. four days; $p = 0.028$). All included patients had a medication history review on admission, while 51.2% received interventions during the hospital stay, 81.6% received a discharge review, and only 18.1% received patient counseling.

Table 2 shows that within 90 days of hospital discharge, four (7.7%) patients in the comprehensive bundle of care group and 72 (19.0%) patients in the partial bundle of care group were readmitted to the hospital ($p = 0.021$). After adjusting for age, gender, diabetes mellitus, ischemic heart disease, chronic kidney disease, comorbidities ≥ 3, polypharmacy ≥ 5, LOS, and ED visits, the adjusted odds ratio (aOR) was 0.27 (95% CI: 0.90–0.82; $p = 0.021$). For ED

Table 1: Demographic and clinical characteristics of the patients stratified into the comprehensive and the partial bundles of care provided by clinical pharmacists (N = 430).

Characteristics	All n (%)	Pharmaceutical bundles of care activities, n (%)		*p*-value
		Partial (n = 378)	Comprehensive (n = 52)	
Age, mean ± SD, years	56.0 ± 21.0	55.0 ± 21.0	58.0 ± 22.0	0.331
Male	188 (43.7)	161 (42.6)	27 (51.9)	0.203
Hypertension	250 (58.1)	216 (57.1)	34 (65.4)	0.259
Diabetes mellitus	196 (45.6)	162 (42.9)	34 (65.4)	0.002
Ischemic heart disease	90 (20.9)	74 (19.6)	16 (30.8)	0.063
Heart failure	47 (10.9)	39 (10.3)	8 (15.4)	0.272
SLE	10 (2.3)	8 (2.1)	2 (3.8)	0.438
Sickle cell disease	14 (3.3)	12 (3.2)	2 (3.8)	0.798
CKD	105 (24.4)	87 (23.0)	18 (34.6)	0.068
LOS, median (IQR), days	4 (2–8)	4 (2–8)	7 (3–11)	0.028
Comorbidities (≥ 3)	137 (31.9)	111 (29.4)	26 (50.0)	0.003
Polypharmacy (≥ 5)	212 (49.3)	174 (46.0)	38 (73.1)	< 0.001

SLE: systemic lupus erythematosus; CKD: chronic kidney disease; LOS: length of hospital stay; IQR: interquartile range.

Table 2: Multivariate logistic regression of the impact of comprehensive versus partial bundle of care activities provided by clinical pharmacists on the rate of 90-day hospital readmissions and emergency department (ED) visits.

Healthcare resource used	N = 430 n (%)	Pharmaceutical bundle of care activities, n (%)		aOR (95% CI)	*p*-value
		Partial (n = 378)	Comprehensive (n = 52)		
90-day hospital readmissions	76 (17.7)	72 (19.0)	4 (7.7)	0.27 (0.90–0.82)	0.021
ED visits	30 (7.0)	28 (7.4)	2 (3.8)	0.56 (0.13–2.56)	0.461

aOR: adjusted odds ratio.

Table 3: Multivariate logistic regression of the impact of clinical pharmacists' counseling, interventions, and discharge medications review on the 90-day hospital readmissions.

Type of the isolated pharmaceutical care activity	90-day hospital readmissions, n (%)	aOR (95% CI)	*p*-value
Counseling			
Provided, n = 78	6 (7.7)	0.28 (0.11–0.71)	0.008
Not provided, n = 352	70 (19.9)		
Interventions during the hospital stay			
Provided, n = 220	34 (15.5)	0.62 (0.35–1.10)	0.101
Not provided, n = 210	42 (20.0)		
Discharge medication review			
Provided, n = 351	63 (17.9)	0.89 (0.44–1.83)	0.757
Not provided, n = 79	13 (16.5)		

aOR: adjusted odds ratio.

visits, two (3.8%) patients in the comprehensive bundle of care group and 28 (7.4%) patients in the partial bundle of care group visited ED ($p = 0.461$).

Table 3 presents the results of the multivariate logistic regression analysis of the isolated clinical pharmacy services. Counseling had a significant impact on the rate of 90-day hospital readmission when compared to those who received counseling and those who did not (aOR = 0.28, 95% CI: 0.11–0.71; $p = 0.008$). Other pharmaceutical services did

not attain statistical significance in relation to the rate of hospital readmission.

DISCUSSION

This is the first study in Oman to compare the effects of different pharmaceutical care services provided by clinical pharmacists, either as a comprehensive or partial bundle, on the rates of 90-day hospital readmission and ED visits. The findings demonstrated a significant reduction in the 90-day readmission rate among patients who received a comprehensive bundle of care compared to those who received a partial bundle of care (p = 0.021). However, no significant difference was observed in the rate of ED visits between the two bundles of care.

The partial bundle of care group had 87.9% of the total included patients, while only 12.1% of the patients were in the comprehensive bundle of care group. The comprehensive bundle of care group had a higher proportion of patients with diabetes, a larger proportion of patients with ≥ 3 comorbidities, and a higher prevalence of polypharmacy (≥ 5 medications) compared to the partial bundle of care group. This could be attributed to the limited availability of clinical pharmacists in the hospital, leading to their services being mainly directed towards high-risk patient groups who require longer hospital stays.[25] It was observed by a previous study from our setting that patients with diabetes stayed longer in the hospital and had a larger proportion of ≥ 3 comorbidities and polypharmacy.[10] Most of the published studies related to pharmacists' activities focused mainly on high-risk groups, elderly patients, patients with specific diseases, or patients admitted to certain medical wards.[14,20,26,27] We recommend further investments in clinical pharmacy services to improve the overall patient's quality of care and outcomes, reduce adverse drug events and related waste of healthcare resources, and prevent patient groups from being denied their service. The multivariate logistic regression analysis adjusted for various factors and showed that patients in the comprehensive bundle of care group were 73.7% less likely to be readmitted to the hospital within 90 days post-discharge compared to those in the partial bundle of care group (aOR = 0.27, 95% CI: 0.90–0.82; p = 0.021). This finding aligns with previous randomized controlled trials, which implemented additional measures such as post-discharge follow-up and specific interventions targeting high-risk patients.[8,15,17,21] For example, Koehler et al,[12] found a statistically significant reduction in 30-day hospital readmission when implementing a supplemental care bundle targeting high-risk elderly inpatients, that consists of providing medication counseling/reconciliation by a clinical pharmacist, condition-specific education/enhanced discharge planning by a care coordinator, and phone follow-up. While, Phatak et al, found that providing an extended intervention (medication review, three motivational interviews, and follow-up with the primary care physician, pharmacy, and nursing home) was associated with a reduction in 30-day hospital readmissions.[21] Similarly, a systematic review suggested that there were several integrated elements of care named multi-component bundles of interventions that strengthen the impact of medication reconciliation on hospital readmission.[20] However, our multivariate logistic regression analysis did not reveal a significant difference between the bundles of care types on ED visits in contrast to other studies that showed lower ED visits when they studied the impact of multiple elements of pharmaceutical care.[8,15,21] Again, to emphasize, these studies had an extra measure that we did not include in our study, which was phone follow-up after hospital discharge. Other studies also recommended phone follow-up as it provides continuity of care for older medical patients.[10,28–30] We recommend that clinical pharmacy service provides a continuity of care post-discharge by using the Comprehensive Medication Management approach that's proven its effectiveness in achieving the quadruple aim of healthcare: reduced healthcare costs, better care, provider well-being, and improved patient experience.[31,32]

When studying the isolated components of pharmaceutical care, our multivariate logistic regression demonstrated that patients who received counseling (18.1%) were significantly associated with a reduction in 90-day hospital readmissions compared with those who did not receive counseling (p = 0.008). This effect was not observed with other isolated interventions or discharge reviews. A systematic review of 43 articles on the impact of isolated and bundled pharmaceutical interventions on hospital readmissions and an observational study for enhancing adherence showed that no pharmacist-led intervention implemented alone was consistently associated with reduced risk of

hospital readmissions.[22,33] Additionally, medication reconciliation alone does not reduce post-discharge hospital resource utilization. However, it may do so when bundled with interventions aimed at improving transition care.[27,34] We suggest, based on these findings, that clinical pharmacists reprioritize counseling as the main closing activity provided to patients during hospitalization and upon discharge. We also recommend that clinical pharmacy services be assessed periodically using a defined set of clinical pharmacy key performance indicators (e.g., hospital readmissions to improve the quality of patient outcomes).[23]

The study acknowledges certain limitations, including the retrospective design and the focus on readmissions and ED visits within a single hospital without considering other healthcare facilities in the country. The differences in patient characteristics between the two bundles of care groups and the heterogeneity of pharmaceutical interventions provided by individual clinical pharmacists also contributed to the limitations of the study.

CONCLUSION

We demonstrated significant reductions in the 90-day readmission rate for patients receiving comprehensive (as opposed to those on partial) bundle of care group but not ED visits. This reiterates the crucial role clinical pharmacists play in reducing healthcare resource use while maintaining optimal pharmaceutical care plans. Further, larger powered studies are warranted to provide a wider insight into the impact of a comprehensive pharmaceutical bundle of care on reducing unnecessary healthcare resources and to address the limitations of our study.

Disclosure
The authors declared no conflicts of interest. No funding was received for this study.

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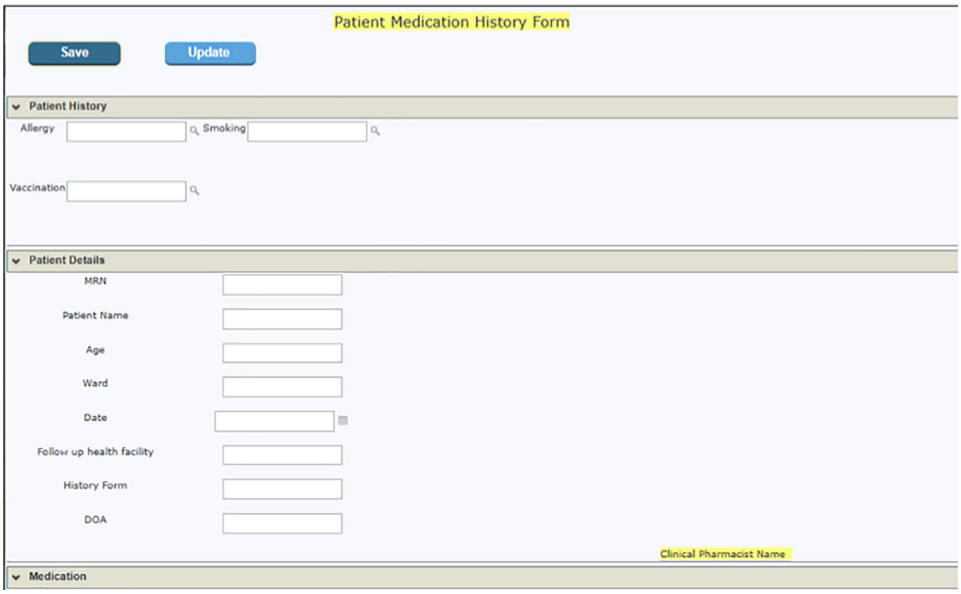
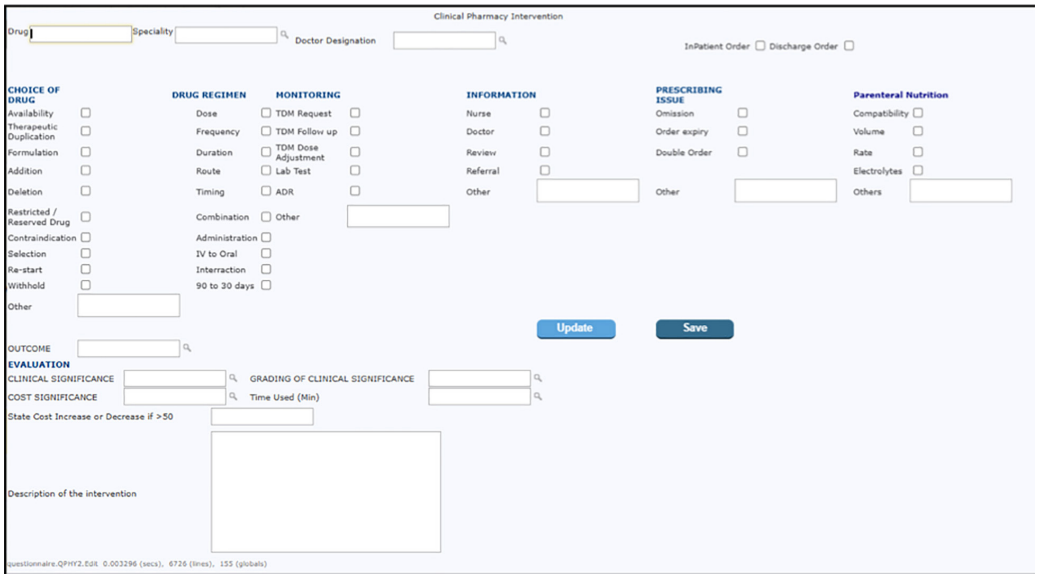
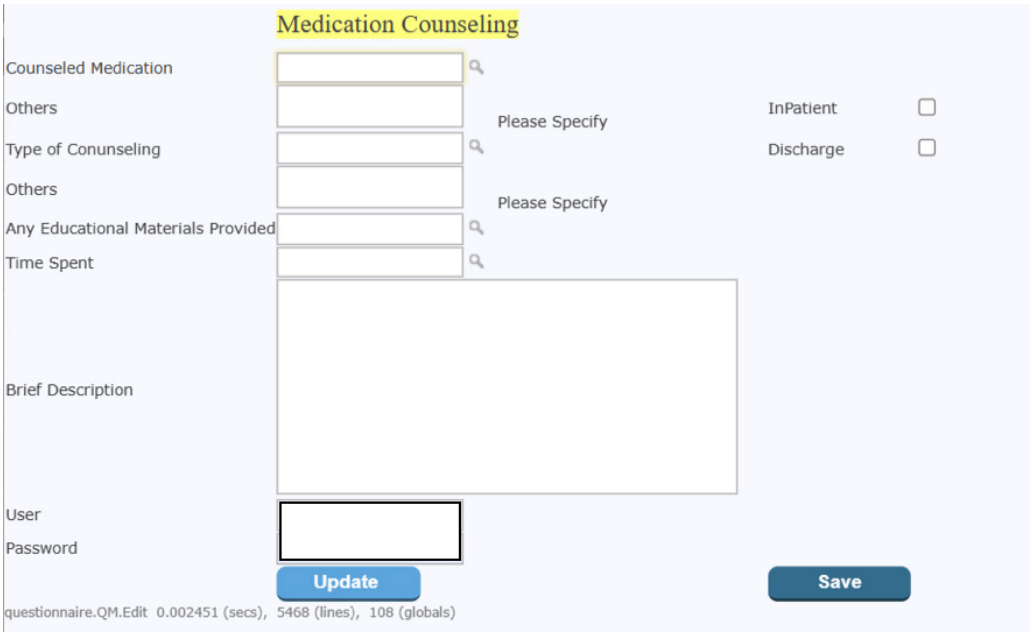
Appendices



Appendix 1: Patient medication history form.



Appendix 2: Clinical pharmacy intervention form.



Appendix 3: Medication counseling form.