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The Burden of Early Hospital Readmission and Drug-Related Factors Associated with Early Hospital Readmission in Jordan: an overview of the literature

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ABSTRACT

Background: Early hospital readmission imposes a significant economic burden on healthcare systems globally. It's also a commonly used measure for quality of care. Several countries exerted substantial efforts to minimize the prevalence of early readmission by understanding the underlying factors and implementing programs to reduce it. This study aims to assess the current knowledge on early hospital readmission in Jordan, including risk factors associated with it, specifically those related to drugs.

Method: Literature searches in PubMed, Scopus, ScienceDirect, Cochrane, and Google Scholar identified 57 studies, 14 of which focused on Jordan's healthcare. Two studies directly addressed early hospital readmission in Jordan; all other 12 studies assessed quality of care issues, including treatment-related problems, drug-related problems, and the importance of the clinical pharmacist's role in improving patients' health outcomes.

Results: A 29% early readmission rate was reported in Jordan, 44% of which were deemed avoidable. Early readmissions were attributed to different factors, including behavioural factors, smoking, non-adherence to medication, discharge against advice, comorbidities, unclear follow-up, and poor discharge plans. Comorbidities were one of the leading factors to increased risk of readmission, accounting for 36% of all readmissions and 47% of avoidable readmissions reported. Moreover, it was found that the presence of certain diseases as pre-existing comorbidities increased the risk of avoidable early readmission substantially. Those comorbidities include digestive, respiratory, circulatory, genitourinary, and parasitic-infectious diseases.

Conclusion: Findings of this review reveal a compelling need for future studies to assess the true implications of early hospital readmission and drug-related factors associated with it.

Keywords: Early hospital readmission; Drug related factors; Medicine related readmission; 30-day readmission; Avoidable readmission; Comorbidities.

INTRODUCTION

Early Hospital Readmission, Unplanned Early Readmission, and 30-day Readmission are all terms used interchangeably for patients who are re-hospitalized within 30 days of their initial hospitalization. Early hospital readmission has been a major concern for health care systems globally. It imposes a significant economic burden on healthcare payers as well as influences the quality of care. According to the United States National Committee for Quality Assurance report in 2012, approximately one out of five patients is readmitted to the hospital within 30 days of discharge, costing the system more than 15 billion dollars annually (1). More recent statistics carried by the Agency of Healthcare Research and Quality (AHRQ) reported an average of 15% early readmission rate from

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2016 to 2020 across the states (2). Comprehensive studies that assessed early readmission rates using the United States-based Nationwide Readmissions Database (NRD) reported similar figures for age-specific and all-cause readmissions. 11.6% early readmission rate was reported among patients of all ages and conditions admitted to hospitals throughout the year 2013 (3). Reports for All-cause and age-group-specific early readmission rates throughout 2017 were 10.5% for the age group 18–44 years, 7.0% for the age group 45–64 years, 12.0% for the age group 65–74 years, and 12.3% for patients who are 75 years or older (4).

As a result of the growing economic burden of early readmissions, The Federal healthcare system started investigating early readmission causes and the contributing factors. This led to the establishment of the Hospital Readmission Reduction Program (HRRP). Hospitals began reporting early readmissions publicly as early as 2010. By 2012, a federal law was passed to penalize hospitals up to 3% on any medical reimbursement for re-hospitalized patients within 30 days of admission. This law was a critical step to encourage hospitals to construct specialized programs to improve patient-care quality during discharge and transition-care (3). Accordingly, a significant decrease in early readmission rates was reported by Medicare and Medicaid throughout the years following the HRRP program. All-cause early readmission rates decreased from 15.1% to 12.0% from 2012 to 2022, respectively (5).

Other countries also directed their attention to the prevalence of early readmissions and risk factors contributing to it. In the United Kingdom, the latest experimental statistics released by the NHS reported an increase of 2.9%, from 12.4% to 15.5%, in early readmission rates over the years of 2013/2014 to 2020/2021 (6). Comparatively, the Swedish National Healthcare System carried out a major prospective trial using the Swedish National Inpatient Register (NPR) to assess the rate of early readmission in the country. Participants were followed from the beginning of the study in 2003 to the end of the study period in 2012. Study findings reported a 43% early readmission rate of all-cause readmissions (7).

In contrast, studies on early hospital readmission in the Middle East region are sparse and limited to small-scale settings that don't reflect the true prevalence of early readmission rates in those countries. To highlight a few, Saudi Arabia reported a 10.18% early readmission rate for a sample size of 200 patients who were admitted to a single hospital (8). Other studies reported a range of 5.2% to 7.2% early readmissions in the pediatric population that was assessed in two hospitals in the region (9-10). Their neighbouring country, Oman, reported a 24% early readmission rate among the geriatric population. Reported factors associated with those readmissions included old age, polypharmacy, and comorbidities. Polypharmacy is one of the significant factors accounting for 25% of the early readmissions reported (11). Syria, on the other hand, reported a rate of admission that was limited to the atrial fibrillation geriatric population that was admitted to a tertiary health centre. While the study population was extremely specific, the study reported a notably high early readmission rate of 43%. This rate exceeds all internationally reported rates (12).

Jordan's healthcare system is known for its advancement in the region, making it a popular destination for medical tourism. This emphasizes the importance of continuous improvement in the healthcare system and overall quality of care provided for patients. Reducing the financial burden of early hospital readmission is an important step to minimize healthcare system costs and reallocate them towards programs to improve the quality of care and overall healthcare outcomes. According to the literature, Jordan has a limited scope on the prevalence of early hospital readmission and risk factors associated with it. A rate of 29% early hospital readmission was reported by a study that assessed a small patient population at a single hospital in the country. 44% of those readmissions

were deemed avoidable and attributed to several factors, including patient-behavioural factors, age, comorbidities, and poor discharge and follow-up plans (13). Comorbidities were reported as one of the leading factors to early readmission, accounting for 36% of early readmissions (14). Study findings reported that the diagnosis of certain diseases as comorbidities at initial hospitalization increased the risk of early readmission significantly. Those comorbidities included digestive, circulatory, respiratory, genitourinary, parasitic, and infectious diseases (14).

Based on the evident burden of early hospital readmission on global healthcare systems and its influence on the quality of care, we assessed the implications of early hospital readmission in Jordan. Focusing mainly on the prevalence of early readmission and factors associated with it, specifically, drug-related factors.

METHODS

We searched PubMed, Science Direct, Scopus, Cochrane, and Google Scholar using a combination of keywords, headings, literature-linked references, and sentence keywords in the years 2000 to 2024. Database sources and the keywords used for this review are listed in Table 1. Study selection criteria included systematic reviews, observational studies, and interventional studies assessing early hospital readmission and drug-related factors associated with early readmission in Jordan. Populations included are all-age patients readmitted within 30 days of admission, including all-cause readmissions, condition-specific readmissions, drug-related readmissions, and potentially preventable readmissions. Readmission studies of ICU patients and post-surgical patients were excluded.

57 published articles were found and reviewed for eligibility. Of the 14 studies matched with the study selection criteria, only two studies directly addressed early hospital readmission in Jordan.

It's also worth mentioning that the two studies are interrelated and research analyses were conducted on the same study population; 3962 internal medicine patients that were admitted at a 527-bed teaching hospital named King Abdullah University Hospital from Dec 2012 to Dec 2013.

RESULTS

Of the 14 studies selected for this review, only two studies directly assessed early hospital readmission and factors associated with it. The primary study assessed the early readmission rate at King Abdullah Teaching Hospital, a major hospital in Jordan, which has 527 beds that can be expanded to 800 beds in emergency cases. 5962 internal medicine patients were admitted from Dec 1st, 2012 to Dec 31st, 2013. A total of 3962 admissions were included in the study; 1157 of those were readmitted within 30 days of hospitalization. The study reported a 29% early readmission rate, and 44% of those were deemed avoidable. Avoidable readmissions were attributed to different factors, including patient-behavioural factors, smoking, non-adherence to medication, discharge against medical advice, age, comorbidities, unclear follow-up, and poor discharge plan (13). To gain a better understanding of the true implications of the attributed factors, researchers used data mining to quantitatively assess the risk of avoidable readmission with respect to the risk factors mentioned. The prediction model reported a 94% risk of readmission for patients who were non-compliant with their prescribed regimen, had no clear follow-up plan, and were admitted at least once or more to the hospital in the past year. On the other hand, young patients who are 33 years or older who were admitted to the hospital two or more times in the past year, with three or more comorbidities, and an unclear discharge and follow-up plan, had an 82% risk of early readmission (13). Leaving against medical advice increased the risk of avoidable readmission by 86%. The risk increased to 89% for those over 60 years of age. Most importantly, 100% of patients who didn't adhere to their

prescribed medical regimen had an avoidable readmission (13).

The second study assessed the burden of existing comorbidities at initial hospitalization as a cause of early readmission and its implication as a risk factor for avoidable readmissions. Findings reported that 36.1% of early readmissions were due to one of the existing comorbidities at initial hospitalization. Also, the adjusted risk of avoidable readmission increased significantly with the presence of specific diseases as comorbidities at initial hospitalization. These comorbidities include digestive, respiratory, circulatory, genitourinary, and parasitic-infectious diseases (14). Specifically, the presence of respiratory system diseases and digestive system diseases as pre-existing comorbidities increased the risk of avoidable readmission by one of those diseases by 38% and 26% respectively (14).

All other studies selected for this review were focused on Treatment-related problems (TRP), Drug-related problems (DRP), Adverse Drug Reactions (ADR), as well as clinical pharmacist practice and its impact on patients' health outcomes. While those studies are extremely valuable, they are out of the scope of this review. Therefore, we provided a comprehensive summary of those studies in Table 2 to provide some insight into those specific topics (15-35).

Table 1: A list of used search engines, keywords, and published articles found in each search engine for this review.

Search engine	Keywords used	Results
Scopus	Drug, readmission, pharmacy, hospitalization, Jordan, Middle East, Hashemite Kingdom	(15–22)
Pubmed	Drug-related readmission in Jordan, medicine-related hospital readmission in Jordan Drug-related hospital readmission in the Hashemite Kingdom, medicine-related problems in Jordan	(23)
Cochrane	Drug-related hospital readmissions in Jordan Hospital admissions in Jordan Medicine-related hospital readmission in Jordan Medicine-related hospital readmission in the Middle East	None
Science Direct	drug-related hospital admissions in Jordan, medicine-related hospital admission in Jordan, medicine-related problems in the Hashemite Kingdom, hospital readmission in Jordan, medication reconciliation in Jordan, avoidable hospital readmissions in Jordan, drug-related hospital readmission	(17) (24-25)
Google Scholar	drug-related hospital admissions in Jordan, medicine-related hospital admission, Jordan, medicine-related problems in the Hashemite kingdom, hospital readmission in Jordan, medication reconciliation in Jordan, avoidable hospital readmissions in Jordan, drug-related problems, hospital readmission	(14-16,19-21,16, 23-30)

Table 2: Comprehensive summary of each of the 14 studies included in this review. Studies assessing DRP, TRP, ADR, and clinical pharmacy practice and its association with patient-care outcomes.

[Author Name]	[Title]	[Aim of the Study]	[Study Design Type]	[Target Population Description]	[Key Findings]	[Study Conclusion]	Medication Review for Readmissions [Yes/No/Not Reviewed] What are the medications?
Alyahya M et al., 2016	Integrating the Principles of Evidence-Based Medicine and Evidence-Based Public Health: Impact on the Quality of Patient Care and Hospital Readmission Rates in Jordan	Identifying modifiable behavioural risk factors associated with potential avoidable hospital readmission	Retrospective Cohort review	Internal medicine patients admitted to King Abdullah University Hospital.	• 29% of all hospitalized patients were readmitted within 30 days • Of all readmissions, 44% were identified as potentially avoidable	Implementing evidence-based health programs that focus on modifiable behavioural risk factors for both patients and clinicians would reduce potentially avoidable readmissions and could reduce direct medical costs.	No
Aldamen et al., 2019	Preventability analysis of adverse drug reactions in a Jordanian hospital: a prospective observational study	To describe the proportion of preventable adverse drug reactions and the causes of hospital-related preventable adverse reactions in one Jordanian hospital	Prospective observational study	Patients included are those who were admitted for at least 24 hours, admitted to medical and surgical wards, and patients admitted due to ADRs. All patients were above 12 years of age.	Of 350 admissions recorded, a total of 38 (10.8%) adverse reactions were detected. 29 of them (8.3%) were detected in the hospital, and 9 (2.6%) were the cause of the hospital admission. Many (44.7%) of the adverse drug reactions were preventable, (31.6% were probably preventable, and 13.1% were definitely preventable). Insufficient monitoring was involved in 29.4% of the preventable adverse reactions, and inappropriate dosing and drug–drug interactions were independently responsible for 17.6% of the preventable adverse reactions.	A high proportion of the identified adverse drug reactions were found to be preventable. Insufficient monitoring and inappropriate dosing were the most important factors associated with preventable adverse drug reactions.	No
Alsobu et al., 2015	Adverse drug reactions experience in a teaching hospital in Jordan	Identify the most common ADRs, drugs implicated in ADRs, and assess their causality, severity, preventability, and risk factors predisposing to reported ADRs in Jordan	Cross-sectional observational study	Patients admitted to the ward or emergency department were examined and asked for ADR, and those who reported them were recruited to the study.	The total number of patients who reported ADR was 64. Within the 64 ADR reports, the number of identified ADRs was 108. 41 drugs were involved in causing these ADRs. Out of the total 64 identified ADRs, 47 (73.4 %) did not cause admission to the hospital, whereas 17 (26.6 %) ADRs were directly involved in admission. Most of the ADRs were type A 40 (62.5 %) compared to 24 (37.5 %) were type B. Regarding ADRs frequency, common ADRs were 59.4 %, were infrequent ADRs were 18.8%, and 21.8 % were identified as rare ADRs. Regarding preventability, the majority of ADRs were classified into "not preventable" (75 %), "definitely preventable" (17.2 %), and (7.8 %) were "probably preventable".	Clinicians and healthcare providers need to recognize ADRs and be more vigilant in detecting, assessing and reporting of ADRs in order to reduce the burden of these ADRs on the healthcare system, and ultimately increase patient safety	Yes. The most common classes of drugs involved in ADRs were antibiotics (Cefotaxime, ceftriaxone, ciprofluxacin, clindamycin, cotrimoxazole, doxycycline, levofloxacin, metronidazole, penicillin, rifampicin, vancomycin) , analgesics (Aspirin diclofenac, ibuprofen celecoxib, paracetamol) vaccines and antiepileptics (Lamotrigine, valproic acid gabapentin)
Jarab et al., 2012	Impact of pharmaceutical care	The aim of the study was to	Randomized, controlled,	One hundred thirty-three COPD patients were	Study results indicated significant improvements in	These study findings	No

[Author Name]	[Title]	[Aim of the Study]	[Study Design Type]	[Target Population Description]	[Key Findings]	[Study Conclusion]	Medication Review for Readmissions [Yes/No/Not Reviewed] What are the medications?
	on health outcomes in patients with COPD	evaluate the impact of pharmaceutical care intervention, with a strong focus on self-management, on a range of clinical and humanistic outcomes in patients with COPD.	prospective clinical trial	randomly assigned to an intervention or a control group. Patients only attend the outpatient COPD clinic at the Royal Medical Services, confirmed diagnosis of COPD by the hospital consultant for at least 1 year, over 35 years old, having a forced expiratory volume in 1 s (FEV_1) of 30–80% of the predicted normal value and hospital consultant agreement that the patient is suitable for entering the trial.	COPD knowledge ($P < 0.001$), medication adherence ($P < 0.05$), medication beliefs ($P < 0.01$), and a significant reduction in hospital admission rates ($P < 0.05$) in intervention patients when compared with control group patients at the end of the study .	demonstrate the value of an enhanced clinical pharmacy service in achieving the desired health outcomes for patients with COPD.	
Jarab et al., 2023	Adverse-drug reaction reporting by Pharm D students during hospital training	The aim was to evaluate Pharm D students' knowledge, attitude, and practice regarding ADR reporting, and the associated barriers and motivators to ADR reporting during clinical training at different hospital sites in Jordan.	Cross-sectional study	sixth year pharm D students during clinical training at different hospital departments in different hospital sites in Jordan	A total of 497 students participated in the study. The participants showed inadequate knowledge regarding ADR reporting, with a mean knowledge score of 3.20 (±1.78). The study participants showed a positive attitude towards ADR reporting with a total mean score of 13.6 (±1.96). However, the ADR reporting practice was low with a mean score of 5.78 (±1.88). Not knowing how to report (60.2%) and not knowing where to report (55.9%) were the most common barriers to ADR reporting, while the most reported motivators for ADR reporting were seriousness of reaction (84.1%) and involvement of new drug (51.1%).	PharmD students showed a positive attitude towards ADR reporting; however, the knowledge and practice of ADR reporting were inadequate, and the participants reported several barriers. Therefore, the topic of ADR reporting and pharmacovigilance, as well as educational training programs, need to be included in future pharmacy curricula in order to improve students' awareness and practice of ADR reporting.	No
Salameh et al., 2019	Impact of pharmacists' directed medication reconciliation on reducing medication discrepancies during transition of care in a hospital setting	To assess the impact of medication reconciliation directed by pharmacists on decreasing medication discrepancies after discharge from the surgical ward.	Randomized, controlled clinical trial	200 patients who fulfilled the study inclusion criteria were allocated from the internal medicine department of Jordan University Hospital. Patients' inclusion criteria are the following: age ≥18 years, using at least four regular pre-admission medications, with more than 48 h expected length of stay in the hospital, speaks Arabic, has no cognitive deficiency, and is not involved in any other clinical trial.	A total of 123 patients met the inclusion criteria, 61 in the intervention group and 62 in the control group. Discrepancies of omission and wrong dose constituted 41 (77%) of the 53 discrepancies in the intervention group and 25 (76%) of the 33 discrepancies in the control group. The number of unintentional discrepancies was significantly reduced from admission to discharge in both the intervention group ($p = 0.002$) and the control group ($p = 0.007$). Of 53 recommendations made by pharmacists, 20 (38%) were accepted by the treating physician, and all of these discrepancies were resolved.	This study sheds light on the existence of unintentional medication discrepancies upon admission for surgical patients, which may expose the patients to potential harm upon discharge from the hospital.	NO
Salameh et al., 2018	Identification of medication discrepancies during hospital admission	Identify the prevalence and types of medication	Prospective observational study	Patients were recruited from all internal medicine department subdivisions, which include: cardiology,	A total of 412 medication discrepancies were identified at the time of hospital admission. Among them, 144	The prevalence of unintentional discrepancies at the time of hospital	NO

[Author Name]	[Title]	[Aim of the Study]	[Study Design Type]	[Target Population Description]	[Key Findings]	[Study Conclusion]	Medication Review for Readmissions [Yes/No/Not Reviewed] What are the medications?
	in Jordan: Prevalence and risk factors	discrepancies at the time of hospital admission to a tertiary care teaching hospital in Jordan, and identify risk factors affecting the occurrence of these discrepancies.		respiratory, hematology/oncology, nephrology, neurology, infectious diseases, gastroenterology, endocrinology, and rheumatology. , age ≥18 years, using at least four regular pre-admission medications, with more than 48 h expected length of stay in the hospital,	(35%) were identified as unintentional, while the remaining 268 (65%) were identified as intentional discrepancies. Ninety-four patients (47%) were found to have at least one unintentional discrepancy, and 92 patients (46%) had at least one documentation error. Among the unintentional discrepancies, 97 (67%) were found to be associated with a potential harm/deterioration to the patients.	admission was alarmingly high. The majority of these discrepancies were associated with a potential harm to the patients.	
Sadeeh et al., 2021	Maximizing acceptance of clinical pharmacy recommendations to reduce length of hospital stay in a private hospital in Amman, Jordan	determine whether clinical pharmacy (CP) may improve outcomes associated with rejected CPI.	Non-interventional Retrospective analysis of pharmacist intervention in a 100-bed hospital	The study consisted of 542 patients, 574 admissions, and 1694 CPI. Using an artificial neural network (ANN) model to determine whether increasing CPI will improve outcomes associated with rejected CPI	All models showed a significant reduction in LOSTA with 100% versus 80% accepted CPI of about 0.4 days (2.6 ± 3.4, median (range) of 2 (0-28) versus 3.0 ± 3.8, 2 (0-30), P-value = 0.022). Average savings with acceptance of those rejected CPI was 55 JD (~ 78 US dollars) and could help hire about 1.3 extra clinical pharmacist full-time equivalents.	Maximizing acceptance of CPI reduced the length of hospital stay in this model. Practicing Clinical Pharmacists may qualify for further privileges, including promotion to a fully independent prescriber status.	NO
Abu-Naser et al., 2021	Impact of Clinical Pharmacist Interventions in Prescribing Errors (PE) in Hospitalized Diabetic Patients with Major Polypharmacy	Investigate the effectiveness of clinical pharmacist interventions in correcting PEs in diabetic patients with major polypharmacy.	Prospective controlled pre- and post-interventional trial	921 patients were included in the study, randomly divided into a control and an active group. Inclusion criteria included patients diagnosed with diabetes mellitus, aged 18 and above, consuming 5 or more medications daily (at least 1 is an insulin or oral hypoglycemic agent).	Results of the study showed a significant reduction in PE among patients in the active group by 89.5%, from 27.6% (control) to 2.9% (active). PEs per patient and PEs per medication orders were reduced from 2.1 to 0.2 and from 0.3 to 0.03, respectively. Electronic selection errors, wrong dose frequency, duplicate drugs, and allergy errors disappeared in the active phase. Significant, serious, and lethal errors were significantly reduced from 35.4%, 11.6%, and 0.2% (control) to 13.5%, 3.1%, and 0.0% (active), respectively.	Clinical pharmacist interventions significantly reduced PEs in patients with diabetes by 89.5% and most of these interventions were clinically significant.	NO
Rababah et al., 2022	Medication errors in Jordan: A systematic review	to assess the prevalence and rate of medication errors reported in different healthcare clinics in Jordan	Systemic review		Prescribing errors were the most common error reported in the included studies, where it was reported in 15 studies. The prevalence of prescribing errors ranged from 0.1% to 96%. Two studies reported unintentional discrepancies and documentation errors as other types of MEs, where the prevalence of unintentional discrepancies ranged from 47% to 67.9%, and the prevalence of documentation errors ranged from 33.7% to 65%.	There is an imperative need to address the issue of MEs and improve drug therapy practice among healthcare professionals by introducing education and training.	NO

[Author Name]	[Title]	[Aim of the Study]	[Study Design Type]	[Target Population Description]	[Key Findings]	[Study Conclusion]	Medication Review for Readmissions [Yes/No/Not Reviewed] What are the medications?
Hammad et al., 2017	The impact of clinical pharmacists in improving Jordanian patients' health outcomes	assess the effect of pharmaceutical interventions on Jordanian patients' clinical outcomes	Systemic review	130 papers were selected, and only 21 met the inclusion criteria. Interventional as well as observational studies performed in community or hospital settings, describing long and short add-on benefits of clinical pharmacy service on process, therapeutic, safety, humanistic, and economic outcomes A total of 6,205 patients were included, adults aged over 18 years old.	Pharmacist interventions resulted in an average reduction (95% CI) in systolic blood pressure of 5.45 mm Hg (2.95-7.92) and diastolic blood pressure of 3.03 mm Hg (1.09-4.96). The mean reduction in glycosylated hemoglobin was 0.75% (-0.49-1.99), and fasting blood sugar was 36.73 mg/dl (-19.7-93.1). The average reduction in low-density lipoprotein cholesterol was 2.36 (1.8-16.62) mg/dl and in triglycerides was 20.16 (6.14-46.47). There was a minimal increase in the level of high-density lipoprotein cholesterol of 1.24 (1.64-4.11) mg/dl. Effects on safety, along with humanistic and economic outcomes and long-term effects, remained unclear.	More studies are needed to understand safety, humanistic, economic, and long-term outcomes.	No
Hijazi et al., 2017	Risk assessment of comorbidities on 30-day avoidable hospital readmissions among internal medicine patients	Assess the influence of index comorbidities on the primary readmission diagnoses and explore the risk of deemed avoidable readmission because of prior comorbidities	A retrospective review	A total of 2025 internal medicine patients. All those who were admitted to the hospital for more than 24 hours, living in the same country, excluding any psychiatric patients and patients who were admitted for observation.	Among all 3962 discharges, 29% were followed by a 30-day readmission, and 13% of those were identified as potentially avoidable. 36% of patients were readmitted because of one of the comorbidities that had been identified at index admission. In addition, 47% of the potentially avoidable readmissions had a main diagnosis that was one of the index comorbidities. The results also showed an association between readmission for one of the index stay's comorbidities and being avoidable.	The presence of certain diseases, being identified as one of the preceding comorbidities, was found to have a substantial influence on the risk of potentially avoidable readmission.	NO
AbuRuz et al., 2011	Comprehensive assessment of treatment-related problems in hospitalized medicine patients in Jordan	Identify the prevalence and classify the types of treatment-related problems (TRP) in hospitalized internal medicine patients and to identify diseases and drugs associated with each specific TRP	Large-scale Prospective trial	402 (33% of all admissions during the study period) patients were included in the study. Age more than 18 years old, At least one acute or chronic medical condition, Receiving at least two medications. And on a daily basis, the following criteria were used to prioritize patients for inclusion: Patients suffering from a higher number of medical conditions, Patients receiving a higher number of medications, Patients with acute conditions requiring frequent monitoring, Patients receiving high-alert medications or medications	The total number of identified TRPs in the study sample was 3,760. The average number of TRPs was 9.35 ± 5.0. Fifty-three percent of identified TRPs were classified as major, and 28.4% were classified as moderate. Efficacy-related problems were the most common TRP category, followed by safety-related problems and indication-related problems. Sixty-four percent of the TRPs were resolved or prevented through the clinical pharmacist's intervention.	We have found that the prevalence of TRPs is substantially high among patients hospitalized at the internal medicine department. TRPs related to Dosage regimens, untreated conditions, patient monitoring, drug interactions, and drug choices were the most common. Most of the TRPs identified by pharmacists were clinically significant. Pharmacists' interventions	NO

[Author Name]	[Title]	[Aim of the Study]	[Study Design Type]	[Target Population Description]	[Key Findings]	[Study Conclusion]	Medication Review for Readmissions [Yes/No/Not Reviewed] What are the medications?
				with a narrow therapeutic index.		contributed substantially to the resolution of many of the identified TRPs	
S. AbuRuz et al., 2021	Impact of pharmacist interventions on drug-related problems in general surgery patients: a randomised controlled trial	Assess the value of a pharmaceutical care service conducted in general surgery wards in the identification and reduction of DRPs in comparison with standard medical care.	Randomized controlled trial	A total of 123 patients were included in the study, randomized into two groups: a control group and an intervention group. Patients older than 18 years diagnosed with one or more chronic or acute medical conditions and taking ≥2 medications on admission were eligible for study entry.	A total of 1062 (range 2–19) DRPs with a mean of 8.6±3.6 were identified during the study period in both groups. All of the study patients had at least one DRP. There were no statistically significant differences in the number of identified DRPs in any of the DRP categories or in the total number of DRPs between the intervention and control groups during hospitalisation. The main commonly identified DRPs (in both groups) were efficacy-related DRPs (19.0%), safety-related DRPs (20.2%), and need for additional monitoring (20.0%). Concerning the efficacy-related DRPs, the need for combination therapy (8.8%) and a more effective drug (6.5%) were the most frequent DRPs. For safety-related DRPs, high dose (6.9%) and safety drug interactions (6.4%) were the most frequent DRPs in the study sample. The majority of the identified DRPs (58.9%) during hospitalisation were corrected (321 recommendations, 208 with physicians and 113 at the patient level). The 321 DRP recommendations were accepted and implemented in the intervention group compared with 75 DRPs (14.5%) in the control group, identified and corrected by physicians and/or nurses. The value of pharmaceutical care was significantly reflected in the achievement of the therapeutic outcomes and prevention of morbidity (resolved/improved or prevented), which was 68.2% (24.2%+44%) in the intervention group compared with 19.2% (12.4%+6.8%) in the control group ($p<0.001$)	This study shows that DRPs are common among general surgery patients in Jordan, especially those related to drug safety and efficacy. Pharmacists' recommendations contributed substantially to resolving most of the identified DRPs and had a significant impact on improving medications used in general surgery patients.	NO

DISCUSSION

The burden of early hospital readmission on healthcare systems has been a challenge for decades. Most developed countries are continuously assessing early readmission rates and factors associated with it and working robustly to minimize them. In our review of the literature, we found

that there is limited knowledge on the national prevalence of early hospital readmission in Jordan. This is due to the small number and scale of studies assessing early hospital readmission in the country. Only two studies were found, both assessed the same patient population who were admitted to general internal medicine services at a single hospital in Jordan. An early readmission rate of 29% was reported; 44% of those readmissions were deemed avoidable and attributed to different factors, including comorbidities and patient-behavioural factors (13-14).

Despite the study-scale limitation, reported figures by the Jordanian study align with international reports on avoidable early readmissions at General internal medicine services: 39%, 40.5% and 53% early readmission rate (27-29). Broader-scale retrospective analysis of all published studies on early hospital readmission from the year 1966 to 2010 reported an average early readmission rate of 27.1% (33).

While Jordanian reports align with international findings and provide valuable insight into early readmission, it doesn't reflect the true prevalence of early readmission at a national level. This is mainly due to the study-scale limitation discussed earlier, emphasizing the need for future comprehensive studies that include more hospitals and larger patient populations to properly estimate the prevalence of early readmissions and risk factors associated with it.

Moreover, the lack of large-scale comprehensive studies on early readmission in Jordan can be attributed to several factors that must be addressed to allow for more efficient and informative research. Potential factors include, but are not limited to: the lack of a standard computerized national reporting system of all admissions in Jordanian hospitals, limited access to patient-care data from public hospitals, and most importantly, the lack of a well-established primary-care system to retain patients' medical history and provide continuity of care. A major step forward to improve national-level healthcare data organization is integrating new technologies similar to those in developed countries. For example, developing a unionized reporting system in public hospitals where patients' records can be accessed and updated upon every admission. Such reporting systems can be beneficial to researchers conducting registry studies at a national level. Another critical drawback to Jordan's healthcare system is the lack of an established primary-care system. By definition of the World Health Organization (WHO), primary care is the key process in a health system that provides promotive, protective, preventative, curative, rehabilitative, and palliative services throughout a patient's life course (36). The implementation of the primary-care system can provide major solutions to several aspects of the earlier discussed issues and improve the overall quality of healthcare in the region. In the presence of primary care, patients' health records would be available across all healthcare centres, allowing healthcare providers to access professionally documented reports that include patients ' medical history, behavioural patterns, lifestyle, medication history, and current health status. Such data can aid healthcare providers in personalizing treatment regimens and provide optimal treatment plans for patients, hence improving overall health outcomes and continuity of care.

Nevertheless, the analysis of risk factors that contributed to the early readmissions reported in Jordanian studies was extensive. Risk factors reported included patient-behavioural factors such as smoking, lack of adherence to prescribed medication, discharge against medical advice, age, number of comorbidities, poor discharge and follow-up plans (13). All factors reported are considered modifiable risk factors that can be reduced. Thus, decreasing the rate of early readmission significantly. For example, smoking increased patients' risk of readmission by 131.5% regardless of age and health conditions. While this figure is extremely high, it comes as no surprise considering the amount of scientific knowledge on the negative implications of smoking on one's general health. On the other hand, lack of adherence to medications, discharge against medical advice, and

receiving a poor discharge plan increased patients' risk of readmission by 100%, 86% and 79% respectively (13). Reflecting on the average person's general medical knowledge and education in Jordan, it's fair to assume that a high percentage of Jordan's population may have at least one of the mentioned risk factors. Therefore, it is important for the healthcare system and care-providers to focus on patient-education on the importance of adherence and compliance to their prescribed medical regimen as directed. Additionally, to raise awareness on the implications of smoking on one's health and implement smoke-free zones across the country. This can be achieved at multiple levels of the healthcare system, beginning with ensuring a well-planned discharge and follow-up for patients who are at high risk of readmission. For example, providing patients with clear written instructions that are well-explained and contact points for further advice. Contact points can be healthcare providers, nurses, pharmacists, or social workers, all of whom are well-trained and informed on post-care medical services. Such services can be provided via phone or in person at specialized public health centres established by the healthcare system. Such changes to the healthcare system will improve patients' awareness, overall health outcomes, and ultimately reduce the potential risk of early readmission.

Comorbidities and the presence of certain diseases at initial hospitalization were also assessed as risk factors of early hospital readmission in Jordan. Findings reported a significant influence of comorbidities on early readmissions, accounting for 36% of all readmissions and 47% of avoidable early readmissions (13-14). The most common diseases associated with early hospital readmission were ischemic heart diseases (IHD), neoplasms, Diabetes Mellitus (DM), Chronic pulmonary diseases, Renal Failure, and vascular diseases. This is likely to be found considering the complexity of each of those diseases and the wide range of symptoms that accompany the disease, making it difficult for patients to manage post-discharge, therefore increasing the risk of early readmission. One can argue that the presence of comorbidities is not a modifiable risk factor; however, providing the proper diagnosis and treatment plan during hospital stay with respect to the diagnosed comorbidities may decrease the risk of early readmission substantially.

Another important finding was the strong association between certain comorbidities diagnosed at initial hospitalization and the risk of avoidable early readmission. Those comorbidities included digestive, respiratory, circulatory, genitourinary, parasitic, and infectious diseases. Patients who were previously diagnosed with chronic respiratory or digestive system diseases and were readmitted due to one of those conditions had an increased relative risk of avoidable readmission by 38% and 23% respectively (14). On the contrary, genitourinary and circulatory pre-existing comorbidities in patients readmitted with those diagnoses decreased the relative risk of early readmission by 16.3% and 10% respectively. Despite the decrease in the relative risk of avoidable readmission, the risk remained significant among those patients. Parasitic and infectious diseases were found to increase the relative risk of avoidable readmission if they were a previous diagnosis, regardless of any comorbidities (14). This data provides valuable insight into the importance of highlighting patients who are diagnosed with certain diseases as high-risk patients and providing the proper treatment plan needed to reduce the risk of readmission.

Jordanian researchers have paved the foundation for future studies to fill the gap in the literature on the national burden of early hospital readmission and potential risk factors associated with it. Specifically, the role of comorbidities in early readmission was extensively assessed by both reviewed studies. However, further assessment of other critical factors associated with early readmission is needed, including hospital-related factors, patient-related factors, and most importantly, drug-related factors. Hospital and drug-related factors are two critical

factors to be considered in early readmission in Jordan. There are several studies in the literature that highlight the implications of those factors on patients' health outcomes. Several studies have assessed the prevalence of treatment-related problems (TRP) in hospitalized internal medicine patients and reported an average of 9.35 TRP; 53 of those problems were classified as major, and 28% classified as moderate (31). Those figures are considered substantial with respect to TRPs' potential contribution to early hospital readmission. The most common TRPs reported were due to dose regimens, drug interaction, drug choice, untreated conditions, and poor patient monitoring (31). One can conclude that all the TRPs mentioned fall under the umbrella of modifiable hospital and drug-related factors, which can be minimized and ultimately reduce the potential risk of early readmission. Drug-related problems have been assessed in hospitalized patients, as it is known to be a common issue among hospitalized patients in Jordan. The common DRPs reported were safety and efficacy, accounting for 20.1% and 19% respectively. Pharmacist intervention reduced DRPs by 58.9% during patients' hospital stay, which improved overall patients' health outcomes and morbidity by 68.2% (32). This emphasizes the importance of assessing drug-related factors associated with early readmission and establishing programs to minimize them, thus improving overall health outcomes and ultimately reducing early readmission rates.

Lastly, there are two major limitations to the studies reviewed: one is the lack of generalizability, as both studies were conducted on a small patient population at one hospital in Jordan. Therefore, findings are not a true reflection of the prevalence of early hospital readmission in the country. Secondly, both studies overlooked critical risk factors that are commonly reported among hospitalized patients in Jordan, which are hospital and drug-related factors.

CONCLUSION

In conclusion, there is a gap in the literature on the true prevalence of early hospital readmission as well as risk factors associated with it. Studies carried out in Jordan were limited in their scale and spectrum of analysis; therefore, future studies are needed to assess the prevalence of early readmission at a larger scale by including multiple hospitals and patient populations. It is also important to explore common risk factors associated with early hospital readmissions, such as drug-related factors and hospital-related factors, to reduce their burden and minimize early readmissions.

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عبء إعادة الإدخال المبكر إلى المستشفى والعوامل المتعلقة بالأدوية المرتبطة بها في الأردن: نظرة عامة على الأدبيات

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ملخص

الخلفية: تشكل إعادة الإدخال المبكر غير المخطط له إلى المستشفى عبئًا اقتصاديًا كبيرًا على أنظمة الرعاية الصحية في جميع أنحاء العالم، كما تُعد مؤشرًا شائع الاستخدام لقياس جودة الرعاية الصحية. وقد بذلت العديد من الدول جهودًا كبيرة للحد من انتشار حالات إعادة الإدخال المبكر، من خلال فهم العوامل المسببة لها وتنفيذ برامج للحد منها. تهدف هذه الدراسة إلى تقييم المعرفة الحالية حول إعادة الإدخال المبكر إلى المستشفيات في الأردن، بما في ذلك العوامل الخطرة المرتبطة بها، وخاصة تلك المتعلقة بالأدوية.

المنهجية: تم إجراء بحث في قواعد البياناتPubMed ، وScopus، وScienceDirect، وCochrane، و Google Scholar، وتم تحديد 57 دراسة، ركزت 14 منها على نظام الرعاية الصحية في الأردن. تناولت دراستان فقط بشكل مباشر موضوع إعادة الإدخال المبكر إلى المستشفى في الأردن، بينما تناولت الدراسات الاثنتا عشرة الأخرى قضايا تتعلق بجودة الرعاية، بما في ذلك المشكلات العلاجية، والمشكلات المتعلقة بالأدوية، وأهمية دور الصيدلي السريري في تحسين نتائج المرضى الصحية.

النتائج: بلغ معدل إعادة إدخال مبكر إلى المستشفى في الأردن 29%، وكان 44% منها قابلًا للتجنب. وقد عُزيت هذه الإعادات المبكرة إلى عدة عوامل، منها العوامل السلوكية الصحية، والتدخين، وعدم الالتزام بتناول الدواء، والخروج ضد نصيحة الطبيب، ووجود أمراض مصاحبة، وعدم وضوح المتابعة، وضعف خطط الخروج من المستشفى. كانت الأمراض المصاحبة (Comorbidities) من أبرز العوامل التي أدت إلى زيادة خطر إعادة الإدخال، حيث شكّلت 36% من إجمالي الإعادات و47% من الإعادات القابلة للتجنب. كما تبين أن وجود أمراض معينة كأمراض مصاحبة سابقة يزيد بشكل ملحوظ من خطر إعادة الإدخال المبكر القابل للتجنب. وتشمل هذه الأمراض :أمراض الجهاز الهضمي، والجهاز التنفسي، والجهاز الدوري، والجهاز البولي التناسلي، والأمراض الطفيلية والمعدية.

الاستنتاج: تشير نتائج هذه المراجعة إلى وجود حاجة ملحّة لإجراء دراسات مستقبلية لتقييم الآثار الحقيقية لإعادة الإدخال المبكر إلى المستشفى والعوامل المتعلقة بالأدوية المرتبطة بها.

الكلمات الدالة: إعادة الإدخال المبكر إلى المستشفى؛ العوامل المرتبطة بالأدوية؛ إعادة الإدخال المتعلقة بالعلاج الدوائي؛ إعادة الإدخال خلال 30 يومًا؛ إعادة الإدخال القابلة للتجنب؛ الأمراض المصاحبة.

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