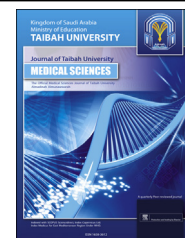Taibah University

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Original Article

Contraindicated medications administered to inpatients with renal insufficiency in a Saudi Arabian hospital that has a computerized clinical decision support system

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الكلوي. هذه الأدوية تنحصر في عدد محدود من الأدوية. وأكدت هذه الدراسة أيضا أن قاعدة بيانات الأدوية في النظام قد تحتاج إلى تحديث بمدخلات من الأطباء المستخدمين للنظام.

الكلمات المفتاحية: القصور الكلوي؛ نظام دعم القرارات السريرية؛ تجاوز؛ تحذير؛ الأدوية المحظورة

الملخص

هدف البحث: تهدف هذه الدراسة إلى تحديد أنواع مختلفة من الأدوية المحظور استخدامها وأعطيت للمرضى الذين يعانون من القصور الكلوي، من قبل الأطباء الذين تجاوزوا التحذيرات التي تقدمها أنظمة دعم القرارات السريرية الحاسوبية.

طرق البحث: تمت هذه الدراسة بأثر رجعي على جميع المرضى المنومين، خلال الفترة من ١ يناير إلى ٣١ ديسمبر ٢٠١٠م، بمستوى كرياتينين > ١.٧مجم/دسل في مستشفى رئيس في المنطقة الشرقية، بالمملكة العربية السعودية. تم استخدام مربع كاي واختبار الانحدار اللوجستي متعدد المتغيرات لتقييم العوامل المرتبطة لاحتمال زيادة المرضى الذين يتلقون الأدوية المحظورة، نظرا لتجاوز الأطباء التحذيرات من أنظمة دعم القرارات السريرية الحاسوبية.

النتائج: تلقى ما مجموعه ٣١٤ مريضا دواء واحدا على الأقل من الأدوية التي يتم التخلص منها عن طريق الكليتين و/أو محتملة الضرر للكليتين. كان ١٤٪ من هذه الأدوية محظورا وأسفر عن تحذير في النظام ومع ذلك أعطيت للمرضى. الأدوية المحظورة حددت بأربعة أدوية: الأسبرين، وجليكلازايد، ونيتروفيورانتوين، وسبيرونولاكتون، ويمثل الأسبرين ٦٠٪ من جميع الأدوية المعطاة للمرضى. أظهر الانحدار اللوجستي متعدد المتغيرات أن احتمالات أخذ هذه الأدوية الأربعة المحظورة تزيد لدى المرضى الذين يعانون من قصور كلوي حاد بعد ضبط العوامل الخارجية.

الاستنتاجات: لازال الأطباء يتجاوزون التحذيرات التي تقدمها أنظمة دعم القرارات السريرية الحاسوبية ويقومون بإعطاء أدوية محظورة لمرضى القصور

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Abstract

Objective: The aim of this study was to determine various types of contraindicated medications that are administered to patients with renal insufficiency by physicians who override alerts provided by the Computerized Decision Support Systems (CDSS).

Methods: This retrospective study incorporated all admitted patients during the period from January 1st through December 31st, 2010, with serum creatinine levels >1.7 mg/dL in a major tertiary hospital in the Eastern Province of the Kingdom of Saudi Arabia (KSA). Chi-square and multivariate logistic regression tests were used to evaluate the factors associated with the increased likelihood of patients receiving contraindicated medication due to physicians overriding the CDSS alert.

Results: A total of 314 patients received at least one medication that was renally cleared and/or potentially nephrotoxic. Fourteen percent of these medications were contraindicated and resulted in a system alert and yet were administered to the patients. The administered

contraindicated medications were limited to 4 drugs: aspirin, gliclazide, nitrofurantoin, and spironolactone, with aspirin accounting for approximately 60% of all of the medications received by patients. Multivariate logistic regression showed that the odds of receiving these four contraindicated drugs increased in those with severe renal insufficiency (OR = 23.4, 95% CI 9.9−54.9, $p < 0.001$) after adjusting for confounding factors.

Conclusion: Physicians override the CDSS alerts and prescribe medications that are contraindicated for patients with renal impairment. These medications are limited in number. This study also emphasizes that the medication database system might need to be updated with input from the physicians using the system.

Keywords: Alert; Clinical decision support system; Contraindicated medications; Override; Renal insufficiency

Introduction

The high prevalence of renal insufficiency in hospital populations and the fact that most drugs and their active metabolites are eliminated through the kidney makes this group of patients highly vulnerable for adverse drug events.[1] Physicians need to consider adjusting the dosage to the level of renal function when prescribing medications to avoid an over dosage, toxicity or further worsening of renal function. With the large number of drugs introduced each year that have varying relationships with the function of the kidney, it is hard for any physician to accurately recall these relations from memory. It is no surprise that several studies have demonstrated high rates of inappropriate dosing for patients with renal insufficiency.[2−4] In a large case-control study, Chertow et al. revealed that the inappropriate prescription of nephrotoxic or renally cleared medications occurred at a rate of 70% in patients hospitalized with renal impairment.[5] In another study, the authors indicated that among 1648 patients, 67% of the drugs prescribed were not adjusted to individual renal function levels.[6] To address this problem, the Institute of Medicine and other influential organizations have endorsed clinical decision support systems (CDSS) as an important strategy for reducing medication errors.[7]

In Saudi Arabia, just as in other parts of the world, medication error is a major concern. Khoja et al. found that 18.7% of all of the prescriptions in an inpatient setting are medication errors.[8] In a paediatric setting, Al- Jeraisy et al. found that overall medication errors were present in 56 per 100 medication orders.[9] Even though reducing medication error is important for all of the patients receiving medical care, patients with renal insufficiency are of particular importance. Not only are they at an increased risk of medication errors and adverse drug events but also the prevalence of chronic kidney disease (CKD) in the Kingdom has been increasing at a fast rate over the last three decades as a result of social and demographic changes.[10,11]

With the mandatory introduction of hospital information systems by the Saudi Ministry of Health, integrating CDSS with the Computerized Physician Order Entry (CPOE) can advise physicians on appropriate dosing for patients at varying levels of renal function at the point of care.[12] However, a number of studies have shown that CDSS had limited success in reducing medication errors.[13−15] The most cited explanation was clinician noncompliance with the alert or advice provided by these systems.[16,17]

Frequent clinically unjustified alerts presented to physicians as they enter their drug orders may result in what has been termed "alert fatigue", which may cause physicians to override clinically important alerts or to even totally abandon the decision support system.[18,19] However, at the same time, medications that result in such alerts are considered by the CDSS knowledge base to be of high risk and are harmful to patients with a compromised kidney reserve. Insight into the medications to which physicians tend to override contraindications may reveal potential problems in the CDSS knowledge database that need to be updated or a lack of knowledge of the medication risks risk by treating physicians that may require more physician training. To better understand these issues, this study aimed to determine the types of contraindicated medications administered to patients with renal insufficiency by physicians who override CDSS alerts in a major Ministry of Health hospital in Saudi Arabia. The study will also examine the factors associated with such overrides.

Materials and Methods

Study setting

This study was conducted in a major Ministry of Health referral hospital providing tertiary care in the Eastern Province, Saudi Arabia. This 600-bed hospital utilizes a commercial electronic medical record (EMR) supported by CDSS that was mandated by the Ministry of Health. This system supports all orders, laboratory results, and patient medication information in the hospital. Computerized order checking for patient-specific parameters with decision support algorithms, including drug−drug interaction, allergies, and drug lab and drug disease interactions, are fully functional. In addition, the system provides advice alerts on drug dosing and avoidance. This study was approved by the Hospital Institutional Review Board.

CDSS and internal logic relevant to renal insufficiency

Each time a newly measured serum creatinine is added by the Lab in the EMR, an estimated creatinine clearance (eCrCl) is calculated according to Cockcroft−Gault (CG) equation.[20] Utilizing a list of drugs that are either renally cleared and/or are potentially nephrotoxic, the internal logic of the commercial CDSS was designed to trigger an *avoid alert* if the physician attempts to order one of the contraindicated drugs according to the most recently calculated eCrCl and predetermined safe cut-off point for