

Physicians' medication prescribing in primary care in Riyadh city, Saudi Arabia. Literature review, part 3: prescribing errors

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وصف الأطباء للأدوية في الرعاية الصحية الأولية في مدينة الرياض، المملكة العربية السعودية، مراجعة للبحوث المنشورة: 3- أخطاء الوصف

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الخلاصة: إن الأخطاء في وصف الأدوية جسيمة على الصعيد العالمي، وتترافق بمعدلات مرتفعة للوفيات وللمرضاة معاً، كما تترافق بتكاليف ضخمة، وبمشكلات قانونية. وتنجم الأخطاء في وصف الأدوية عن عوامل عدة تتعلق بالقائمين على إيتاء الرعاية الصحية، وبالمراجعين، وبالنظام الصحي. إلا أن معظم أخطاء وصف الأدوية يمكن تفاديها. وهذه الورقة هي الثالثة من ثلاث من مقالات المراجعة تمثل خلفيّة تشكّل المعلومات الأساسية لسلسلة دراسات من خمس حلقات، حول أنماط الوصف للأدوية، وأخطاء وصف الأدوية، في قطاعي الرعاية الصحية الأولية الخاص والعام، في المملكة العربية السعودية. وقد أجرى الباحثون بحثاً في خط استرجاع المعلومات على الإنترنت (ميدلاين) للتعرف على الأوراق التي نشرت في مجلات محكمة على مدى العقود الثلاثة المنصرمة. وتعرض هذه الورقة سببّات الأمراض، واستراتيجيات الوقاية، وآليات الإبلاغ، وعواقب العدد الكبير من أخطاء وصف الأدوية.

ABSTRACT Medication errors are globally huge in magnitude and associated with high morbidity and mortality together with high costs and legal problems. Medication errors are caused by multiple factors related to health providers, consumers and health system, but most prescribing errors are preventable. This paper is the third of 3 review articles that form the background for a series of 5 interconnected studies of prescribing patterns and medication errors in the public and private primary health care sectors of Saudi Arabia. A MEDLINE search was conducted to identify papers published in peer-reviewed journals over the previous 3 decades. The paper reviews the etiology, prevention strategies, reporting mechanisms and the myriad consequences of medication errors.

Comportement prescripteur des médecins en soins de santé primaires à Riyadh (Arabie saoudite). Examen des publications, troisième partie : les erreurs de prescription

RÉSUMÉ Au plan mondial, les erreurs de médication ont une très grande portée et sont associées à une morbidité et une mortalité élevées ainsi qu'à des coûts importants et des problèmes juridiques. Les erreurs de prescription sont causées par une multitude de facteurs liés aux prestataires de soins, aux consommateurs et au système de santé. Par ailleurs, la plupart des erreurs de prescriptions sont évitables. Le présent article est le dernier de trois articles de synthèse qui constituent le contexte de recherche d'une série de cinq études interdépendantes sur les modes de prescription et les erreurs de médication dans les secteurs public et privé des soins de santé primaires en Arabie saoudite. Une recherche sur MEDLINE a été réalisée pour identifier les travaux publiés dans des revues pratiquant l'examen collégial au cours des trente dernières années. Le présent article analyse l'étiologie, les stratégies de prévention, les mécanismes de notification et les multiples conséquences des erreurs de médication.

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Introduction

The issue of medication prescribing errors was little discussed until 1962, when Barker and McConnell in the United States of America (USA) first demonstrated that medication errors occur more frequently than suspected. They estimated a rate of 16 errors per 100 doses [1] and suggested that the apparent increasing rate of prescribing errors was proportionate to the increasing number of drugs available. Subsequently, reporting systems for reporting medication errors were set up in the USA and Europe [2,3]. Health care professionals who encounter actual or potential medication errors are encouraged to report them confidentially, or anonymously if preferred. In 1995, a multidisciplinary group of 17 national organizations formed the National Coordinating Council for Medication Error Reporting and Prevention. Since then there have been many other landmark developments with regard to reporting of prescribing errors [2].

There are few studies from Gulf countries that explore medication prescribing errors in different settings, and in primary health care (PHC) in particular, compared with more industrialized countries. This paper is the third of 3 review articles that form the background for a series of 5 interconnected studies of prescribing patterns and medication errors in the public and private primary health care sectors of Saudi Arabia [4–8].

Prescribing errors: the size and nature of the problem

Adverse drug events (ADEs) occur when a drug causes injury but ADEs that are associated with a prescribing error are considered preventable. ADEs due to prescribing errors are thought to cause considerable mortality and morbidity in hospital patients and are

associated with a huge annual cost, estimated to be US\$ 17–29 billion per year in US hospitals [9,10]. Prescribing errors occur much more frequently than ADEs, although fortunately most have little potential for harm [11]. It has been estimated that 3%–24% of all prescriptions contain errors [12,13]. Medication errors occur between 5 and 80 times per 100 000 consultations, mainly related to the processes involved in diagnosis and treatment [12]. Prescribing and prescription errors have been identified in up to 11% of all prescriptions in PHC, mainly related to errors in dosage.

An understanding of the true frequency and nature of medication errors is complicated by the different definitions and methods used in the studies. In PHC, further research is warranted to understand the complex nature and causes of the errors that occur so that appropriate policy decisions can be made to improve patient safety [12]. A multi-centre audit in the United Kingdom (UK), Germany and France reported 81 medication error incidents in hospitals, mainly due to incorrect doses, which involved 1144 children. There were at least 29 deaths, 9 of which involved neonates. The researchers suggested that there was a need for a national surveillance scheme for medication errors in paediatric patients [13]. In another study discrepancies in prescribing occurred for 39 out of 43 patients being transferred between primary and secondary care [14]. Discrepancies at the time of admission occurred for 69% of drugs studied and, following discharge, for 43% of drugs. It was estimated that harm would occur to the patient, should the discrepancies be reproduced, in 24% of cases at admission and 18% of cases at discharge respectively. In a study of intravenous medication errors in the UK and Germany, it was found that omission errors and incorrect rates of administration occurred frequently, with moderate to severe adverse outcomes [15]. A high rate of the drug errors were related to intravenous drug

doses (49%), mostly when giving bolus doses or when making up an injection requiring multiple steps [16]. In a case study, Bates discussed the multiple issues surrounding a medication error in a 40-year-old woman in the course of outpatient care [17]. The author suggested that drug safety will be improved only when prescriptions can be sent electronically to the pharmacy site, thus reducing handling by different people, and that health care providers must focus on electronic dispensing of drugs. In a study of inpatients, it was reported that 81% of patients had drug-related problems and the most commonly involved drugs were warfarin, digoxin and prednisolone, with calculated benefit/risk ratios of 0.48, 0.42 and 0.26 respectively [18]. Gandhi et al. found that 79% of reported complications among outpatients related to use of prescription drugs [19].

Dean et al. used the Delphi consensus method to develop a definition of prescribing errors for use in quantitative studies of incidence [20]. Health care professionals were in broad agreement about the types of events that should be included and excluded as prescribing errors. In general, transcription errors, failure to communicate essential information and the use of drugs or doses inappropriate for the individual patient were considered prescribing errors; deviations from policies or guidelines were not.

There are difficulties, however, when the definition of prescribing error varies and gives rise to differences in the reported rates of errors, e.g. rates of 0.4% to 1.9% in various USA studies compared with 1.5% in a UK hospital setting [20]. Other variations arise from different geographical settings and study institutions [21]. There has been an apparent increase in ADEs, which may be due to better recognition of errors rather than a true increase: over the past 15 years fatalities from recognized prescription errors have allegedly more than tripled from 2876 to 9856 in the USA.

Prescribing errors and their diversity across studies have been recently explored in PHC [12] and 15 prevention strategies for reducing medication errors in ambulatory practice have been described [22]. In a meta-analysis of 38 studies evaluating interventions to reducing ADEs in PHC, Royal et al. found relatively weak evidence that pharmacist-led medication reviews were effective in reducing hospital admissions [23]. There is currently no evidence for the effectiveness of other interventions which aim to reduce hospital admissions or preventable drug-related morbidity, and there is a need for more randomized controlled trials of PHC-based interventions.

In a related development in the UK up to 55% of general practitioner (GP) consultations end in a drug prescription [24] and in the USA up to 70% of all physician office visits result in a prescription [25]. Whether or not issuing a prescription is a true reflection of the level of patient's illness, and is the correct treatment strategy, is in many cases uncertain. Some researchers have discussed the safety of drug use in the context of PHC by understanding the system in which the drug is prescribed [26].

Prescribing error database collecting mechanisms

In some industrialized countries, there are databases that help licensing authorities to study the utilization of drugs [27]. Despite some deficiencies, such as missing data, these drug reporting systems can be used to address issues related to medication errors and patient safety [28], such as evaluating errors and providing feedback. They bring openness and transparency to the reporting of medication errors and allow the genesis of and processes underlying such errors to be analysed in detail.

Consequences of prescribing errors

In an influential editorial in 2001, MacKinnon stated that ADEs were pandemic, and were increasing worldwide. ADEs due to medication errors are claimed to be the 5th most common cause of deaths globally [29]. Others have estimated that about 25% of hospital deaths due to medication errors are preventable [30].

Prescribing errors cause a wide range of potentially serious health problems. ADEs, a large proportion of which are likely to be related to prescribing errors, cause an estimated 850 000 episodes of illness within the UK national health service [31–36]. The Institute of Medicine (IOM) report found that medication errors in the US killed 7000 people annually at a cost of US\$ 2 billion [37]. These studies were mainly hospital-based and some researchers have questioned whether rates selectively reported from hospitals are representative of international trends [38,39], in part because in some studies the risks of death due to medication errors were not separated from expected deaths due to the patient's illness [30]. Other researchers reaffirm the high rates but acknowledge that data from some studies may have been overestimates, sometimes even for non-medical reasons [40].

Prescribing errors in paediatrics: a more vulnerable population

Prescribing errors have also been analysed in children, who are an especially vulnerable population because they are less capable of capturing dose-related errors dispensed wrongly by pharmacists. Typical errors involve mathematical calculations and decimal point misplacement in 27.9% of drug prescriptions [41,42]. Buck also highlighted the prescribing dose calculation

errors in children and suggested some tips for medication prescribers, which are also applicable to prescribing for adults and the elderly [43]. Kaushal et al. explored patterns of medication errors and ADEs in paediatric settings, together with preventive strategies, and found that medication errors were reported in 5.7% of paediatric patients [44]. Walsh et al. have also reviewed strategies for reducing paediatric medication errors [45]. In general, studies on drug prescribing in paediatric patients [44] are relatively few in number compared with those in the adult population and this is therefore an important avenue for further research.

Causes of medication errors

Prescribing errors caused by multiple factors related to health professionals and health systems [9,12,13,46–49] will be reviewed here in some detail.

Prescriber-related errors

Errors from the prescribing process are a key factor in medication errors. Lack of knowledge on the part of the prescriber is one cause of medication error, e.g. when a physician is inexperienced, uses outdated therapeutic protocols or does not update his/her knowledge based on new evidence for particular drugs [50]. Physicians are often required to write a prescription when the diagnosis is far from clear and a pattern of prescribing ineffective or even dangerous therapy may become established.

Poorly written prescriptions are another aspect of prescriber-related errors. Illegible handwriting may cause medication errors if there is misinterpretation of medication names or brand-name drugs, or if the incorrect doses or incomplete orders are dispensed [51,52]. The use of abbreviations in prescriptions is now discouraged [53].

Mehta et al. found that adverse clinical outcomes due to incorrect doses of

drugs may not have a direct cause and effect, but are attributable to confounding factors in patients who are at high risk of ADEs and are prone to dosing errors [54].

Sandars and Esmail reviewed the relevant literature in PHC and found that methodological differences, along with inconsistent definitions of error, were the underlying causes of diverse incidents of medication error [12].

Other mistakes made by prescribers are multifaceted. Medication errors can occur when transferring patients, e.g. as shown by a study of elderly patients transferred between primary and secondary care [55]. Such errors can be reduced by proper documentation and transfer data concerning medications. Applying Reason's concept of industrial accident causation, Dean et al. prospectively identified causes of prescribing errors in hospital inpatients [48]. Most mistakes were made because of lapses of attention by prescribers or because prescribers did not apply the relevant rules or failed to identify risk factors. In contrast to these qualitative studies, a systematic review of resident physicians found that reducing their working hours had no effect on patient safety [56]. It seems likely that these factors may apply equally to prescribing in PHC.

Patient-related errors

The second main factor in medication errors is related to errors by patients. These are mainly due to mistakes in the use of the drug, and of course a higher number of prescription items increases the risk of errors. Therefore a key responsibility of all health care professionals is to explain clearly to patients how to take their medication.

The risk of medication errors is also related to patients' characteristics, as illustrated by high reported rates of medication errors involving black male and female patients compared with their white counterparts [57,58]. Other patient factors such as extreme age and weight are also associated with a

greater risk of medication error [59]. A substantial proportion of older patients on high-risk medications do not recall receiving instructions about the use of their medications and do not take advantage of existing systems for organizing their medication regimen [60].

Another component in patient-related errors is compliance. The traditional concept of full patient compliance with the doctors' orders has been replaced by more modern ideas such as adherence and concordance. A variety of factors affecting doctor-patient concordance have been explored [61] and a considerable literature exists on the correlates of concordance/non-concordance rates between patient and prescribing physician. In 1 study, younger age of patients, financial strain, low self-rated health and low trust in the health-care system were associated with primary non-concordance with medication use [62].

Pharmacist-related errors

Finally, errors by pharmacists in dispensing drugs are an important cause of medication error, and many factors have been identified. The reported rate of dispensing errors ranges from 3.8% to 12.4% [63], and these can be attributed to a number of factors, including untrained support staff [64] and overwhelming workload in health-care systems [65]. Pharmacy personnel make common errors in calculations, in preparation and compounding, and in dispensing and distributing medications, partly due to systems failure. On the other hand, pharmacists are key players in the prevention of medication errors by checking for incorrect prescriptions written by physicians.

Legal implications and ethics of medication errors

Ferner observed 4 important legal points in medication errors that have led to manslaughter charges and noted that

the system for dealing with medication errors needs to be non-punitive [66]. Patients and doctors would be safer if an independent inquiry were guaranteed and the criminal law were reserved for those doctors who show "such disregard for life and safety as to amount to a crime against the state" [66].

On a separate issue, reviewers have discussed the legal, ethical and practical aspects of medication errors and argued that the disclosure of errors to patients should be candid and timely and that this can lessen, rather than increase, the likelihood of medicolegal action [67]. They further pointed out that in cases of professional negligence or systems failure resulting in serious harm to patients, there should be a prompt response to prevent further occurrences and to provide patients with the right to redress.

While allegations of negligence, criminal court rulings against doctors and nurses and financial compensation related to medication errors are common in advanced countries, they are still very rare events in Gulf countries. But with the increasing education level of the population, it is likely that the authority of the doctor may increasingly become eroded and litigation against doctors may become more common in Saudi Arabia in the future.

Prevention of medication errors

Despite their multiple etiologies, prescribing errors are amenable to prevention. Even though the mortality rate and financial costs due to medical errors may not be excessive, health authorities should implement preventive strategies based on theories of behavioural change that should target identified influences on prescribing behaviour of health providers and consumers [68].

Role of pharmacists

Pharmacists have a key role in avoiding prescribing errors, both their own and

those of physicians. Buurma et al. reported on the role of pharmacists in intervening to modify prescription errors [69]. By extrapolation, they estimated a daily occurrence of approximately 2700 positive interventions in all Dutch pharmacies, i.e. 1.6 per pharmacy per day. In a list of strategies for improving the safety of drug delivery, MacKinnon highlighted the role of pharmacists in preventing medication errors [29]. He suggested pushing for better medication use standards to protect the public and to lower the “quality tax” on superior producers who are producing a higher quality service for standard remuneration. Such improvements would then force “marginal operators” to improve or leave the industry. Helling too has suggested a more proactive role for pharmacists and nurses in improving drug-use systems and enhancing patient safety through reduction of medication errors [70].

Kelly has discussed the underlying causes of pharmacy-related medication errors and proposed several preventive strategies including errors due to system failure, errors due to insufficient supervision or staffing and errors by pharmacy personnel, such as calculation errors, preparation and compounding errors, dispensing and distributing errors [71]. This summary analysis reported that faulty prescribing was the most common reason for medication errors and that incorrect dosage was the most common type of error accompanying lawsuits in 13% of cases.

Millonig et al. reviewed and discussed the significance of pharmacists' access to patient-specific health care information in relation in reducing patients' risk of medication-related problems [72]. Participation by pharmacists in post-admission ward rounds was shown to reduce both medication errors and prescribing costs in teaching hospitals in the USA and UK [73]. Another benefit of involving pharmacists in prevention of medication errors is that they have demonstrated very

positive attitudes towards medication error reporting [74].

Role of physicians

According to Dean et al. medication errors are preventable in at least 25% of cases in hospital inpatients, and can be greatly reduced if certain guidelines are adopted. Their 9 simple and pragmatic recommendations focused mainly on doctors' behaviour in a hospital setting [48].

It has been reported that nearly half of all physician errors are intercepted, 86% by nurses and 12% by pharmacists [75]. Likewise, one-third of order transcription and dispensing errors are discovered prior to administration. The stage of medication administration is the most vulnerable to errors that adversely affect patient care, because only 2% of such errors are intercepted. According to Ferner, medication errors are unacceptably common and unforeseen difficulties can arise whenever a change is made to hospital systems [76].

As well as accurate prescription writing, physicians also need to take account of other medications being used by patients when they are prescribing. It has been reported that while 86% of physicians enquired about the patient's use of over-the-counter drugs, less than 50% of them took account of the use of herbal drugs before prescribing a new therapy [77]. Notably, non-prescription drugs may interact adversely with prescription drugs and lead to ADEs and other comorbid disorders.

It is recommended that doctors in all health settings should report ADEs routinely as this helps prevent further prescribing errors [78–81]. This will not happen, however, if doctors fear being blamed for ADEs. It has been argued that an anonymous system of reporting is required, akin to aircraft pilots reporting “near miss” aircraft incidents [29]. To support this, a reliable and valid way of assessing the severity of medication errors is needed, especially in view of the medicolegal consequences [82,83].

One group of researchers has validated a series of 29 indicators for preventing drug-related morbidity—selected out of 57 indicators using a 2-round Delphi technique; these aim to facilitate a reduction in the human, clinical and economic burden of drug-related morbidity [84].

Role of computerized prescribing systems

In addition to the solutions mentioned earlier for preventing such errors, computer reminder systems and computerized drug interaction alerts may assist in the prevention of medication errors [85]. The introduction of electronic prescribing systems may considerably reduce medication errors, enhance the quality of prescribing and efficiency of physicians, and reduce the cost of prescribing [86]. More studies are needed to collect the evidence to substantiate or refute these views. Computerized physician order entry (CPOE) systems have been shown to enhance patient safety by decreasing ADEs in a paediatric hospital [87]. Wilson and Sheikh have highlighted some important problems with computerized systems for prescribing and also outlined 7 steps to promote prescribing safety in PHC [88]: understand systems; leadership and culture; research; event analysis; establish best practice; use improvement techniques and technology; and monitor safety.

It is claimed that about 74% of avoidable medication errors could be eliminated by computerized prescribing systems [89], including barcode-enabled point-of-care (BPOC) technology. This aims to protect patients from prescription and dispensing errors as well as administration errors by providing checks at the point-of-care, i.e. at administration rather than dispensing of medications. BOPC has different levels of sophistication from level 1 which automates checking the 5 rights (right patient, right medication, right dose, right time and right route of

administration) to level 3 with computer logic and rules engines to provide decision support information related to high-risk situations such as look-alike/sound-alike drug names, patient allergies and clinical guidance regarding the effects and undesirable effects of some medications. Several studies have reported that BPOC systems lead to a 65%–74% decrease in medication errors [89,90]. Researchers also found that computer-assisted prescriptions were more than 3 times less likely to contain errors and 5 times less likely to require pharmacist clarification than handwritten prescriptions [91].

Avery et al. established a consensus on the most important safety features of physicians' computer systems in PHC [92]. There was a high level of agreement among the panel of experts about the need for computerized alerts and the need to avoid spurious alerts. Ironically, Ferner reported that highly computerized hospitals have high rates of ADEs and not simply better reporting of such events [93]. The study concluded that high rates of ADEs may continue after implementation of CPOE and related computerized medication systems if these lack decision support processes for drug selection, dosing and monitoring. Therefore while computerized systems may be helpful in highlighting the existence and extent of ADEs, they have a limited impact in ameliorating such problems.

Role of nurses

Nurses too can have a positive role in preventing ADEs and prescribing errors. First, they can act to prevent the dispensing of drugs against poorly written prescriptions by doctors. Nurses empowered to report ADEs were shown to be as effective as doctors, and this has led to extension of their powers to write yellow cards reporting ADEs [94].

Secondly, as dispensers of drugs to patients in hospitals, nurses themselves may be a source of medication errors, e.g. by issuing the wrong drug to a particular

patient or making errors in dosage or timing. According to Pape et al. factors increasing the risk of medication errors by nurses include multiple distractions and interruptions and a lack of focus during tasks. They demonstrated the effectiveness of innovative approaches such as protocol checklists and visible signage tools to help avert medication errors [95].

In the UK at least, nurses now have prescribing rights, after receiving additional training similar to that of doctors. Whether these nurses are now prone to the same prescribing errors as doctors remains a matter for further study.

Role of medication use systems

In a workshop on information systems solutions to medication errors, comprehensive guidelines and recommendations emerged for improving medication systems, applying technology and preventing human error, and for medical, nursing and pharmacy staff to achieve better outcomes for patients [96]. Systems failures rather than individual error were thought to be the major causes of medication errors. Besides other recommendations, medication error prevention strategies that were highlighted were as follows: assess risk from medical errors; audit outcomes information systems; mandatory reporting of errors; use of databases and tools; simplification of key processes such as physicians order entry; design job for safety; reduce reliance on memory; use behaviour-shaping constraints (a technique to prevent the user from making common errors or mistakes); and standardization of work processes [96]. There is a constant need to redesign systems in such a way as to facilitate the detection and prevention of medication errors [40]. Notably, there is surprisingly little evidence that interventions reduce the risk of medication errors [97]. CPOE, simulation, team training programmes, root cause analysis, barcoding and error reporting

systems were not found to reduce errors in such trials [98]. Health care providers should be cautious in utilizing these untested preventive strategies in reducing medical errors.

Role of health care consumers

Patients have a special role in reducing medication errors and enhancing their own safety [17]. Patients should be encouraged to give details of their non-prescription medications to physicians and ask for relevant details about drugs they have been prescribed. Patients should also check their prescriptions every time they refill them and, most importantly, should notify the pharmacist of any change in medications before using them. Weingart et al. reported on a promising strategy to involve inpatients in a partnership to prevent ADEs by giving them more information about their medication, although they called for more studies to establish the efficacy of this [99].

To summarize, medication errors are frequent in hospitals, in tertiary care settings and also in PHC. They are also under-reported. The exact frequency of under-reporting is not clear as different studies have used varying definitions and methods.

Prescribing errors are caused by multiple factors related to health care providers, consumers and systems, and can occur during any stage of medication use. They can cause substantial disability and morbidity and even mortality, as well as wasting resources which could be better used in other ways. They undermine public confidence in the practice of medicine and in the health care systems. A great proportion of medication errors would be avoidable if preventive strategies were applied by health providers and if such measures were incorporated into systems for monitoring the quality of all health care settings [100], especially private practice settings, which are an important part of the overall health care system in Saudi Arabia.

References

1. Barker KN, McConnel WE. How to detect medication errors. *Modern Hospital*, 1962, 99:95-106.
2. Leape LL. Reporting of adverse events. *New England Journal of Medicine*, 2002, 347(20):1633-1638.
3. About the National Reporting and Learning Service. *National Patient Safety Agency* [website] (<http://www.nrls.npsa.nhs.uk/about-us/>, accessed 12 December 2010).
4. Neyaz Y et al. Medication prescribing pattern in primary care in Riyadh city, Saudi Arabia. *Eastern Mediterranean Health Journal*, 2011, 17(2):149-155.
5. Khoja T et al. Medication errors in primary care in Riyadh city, Saudi Arabia. *Eastern Mediterranean Health Journal*, 2011, 17(2):156-159.
6. Magzoub MA et al. Determinants of physicians' medication prescribing behaviour in primary care in Riyadh city, Saudi Arabia. *Eastern Mediterranean Health Journal*, 2011, 17(2):160-166.
7. Neyaz Y et al. Predictors of quality of medication prescribing in primary care in Riyadh city, Saudi Arabia. *Eastern Mediterranean Health Journal*, 2011, 17(2):167-171.
8. Qureshi NA et al. Effectiveness of three interventions on primary care physicians' medication prescribing in Riyadh city, Saudi Arabia. *Eastern Mediterranean Health Journal*, 2011, 17(2):172-179.
9. Kohn LT, Corrigan JM, Donaldson MS, eds. *To err is human. Building a safer health system*. Washington DC, National Academy Press, 2000:23.
10. Bates DW et al. The costs of adverse drug events in hospitalized patients. Adverse Drug Events Prevention Study Group. *Journal of the American Medical Association*, 1997, 277:307-311.
11. Bates DW. Unexpected hypoglycemia in a critically ill patient. *Annals of Internal Medicine*, 2002, 137:110-116.
12. Sandars J, Esmail A. The frequency and nature of medical error in primary care: understanding the diversity across studies. *Family Practice*, 2003, 20:231-236.
13. Cousins DH et al. Medication errors in intravenous drug preparation and administration: a multi-centre audit in the UK, Germany and France. *Quality and Safety in Health Care*, 2005, 14:190-195.
14. Morcos S, Francis SA, Duggan C. Where are the weakest links? A descriptive study of discrepancies in prescribing between primary and secondary sectors of mental health service provision. *Psychiatric Bulletin*, 2002, 26:371-374.
15. Wirtz V, Taxis K, Barber ND. An observational study of intravenous medication errors in the United Kingdom and in Germany. *Pharmacy World and Science*, 2003, 25:104-111.
16. Taxis K, Barber ND. Ethnographic study of incidence and severity of intravenous drug errors. *British Medical Journal*, 2003, 326:684.
17. Bates DW. A 40-year-old woman who noticed a medication error. *Journal of the American Medical Association*, 2001, 285:3134-3140.
18. Blix HS et al. The majority of hospitalized patients have drug-related problems: results from a prospective study in general hospitals. *European Journal of Clinical Pharmacology*, 2004, 60:651-658.
19. Gandhi TK et al. Drug complications in outpatients. *Journal of General Internal Medicine*, 2000, 15:149-154.
20. Dean B, Barber N, Schachter M. What is a prescribing error? *Quality in Health Care* 2000; 9:232-237.
21. Phillips DP, Bredder CC. Morbidity and mortality from medical errors: an increasingly serious public health problem. *Annual Review of Public Health*, 2002, 23:135-150.
22. Adubofour KO et al. Strategies to reduce medication errors in ambulatory practice. *Journal of the National Medical Association*, 2004, 96:1558-1564.
23. Royal S et al. Interventions in primary care to reduce medication related adverse events and hospital admissions: systematic review and meta-analysis. *Quality and Safety in Health Care*, 2006, 15:23-31.
24. Webb S, Lloyd M. Prescribing and referral in general practice: a study of patients' expectations and doctors actions. *British Journal of General Practice*, 1994, 44:165-169.
25. American Medical Association White Paper on Elderly Health. Report of the Council on Scientific Affairs. *Archives of Internal Medicine*, 1990, 150:2459-2472.
26. Avery AJ et al. Safer medicines management in primary care. *British Journal of General Practice*, 2002, 52S:17-22.
27. Taylor R. National and international patterns of drug use. In: Hobbs R, Bradley C, eds. *Prescribing in primary care*. Oxford, Oxford University Press, 1998:9-35
28. Cohen MR, ed. *Medication errors*. Washington DC, American Pharmaceutical Association, 1999.
29. MacKinnon NJ. Seven strategies to strengthen our medication-use system. *Californian Journal of Health Promotion*, 2001, 54:72-74.
30. Hayward RA, Hofer TP. Estimating hospital deaths due to medical errors: preventability is in the eye of the reviewer. *Journal of the American Medical Association*, 2001, 286:415-420.
31. Brennan TA et al. Incidence of adverse events and negligence in hospitalized patients: results of the Harvard Medical Practice Study 1. *New England Journal of Medicine*, 1991, 324:370-376.
32. Leape LL. Error in medicine. *Journal of the American Medical Association*, 1994, 272:1851-1857.
33. Johnson JA, Bootman JL. Drug-related morbidity and mortality: a cost-of-illness model. *Archives of Internal Medicine*, 1995, 155:1949-1956.
34. Rochon PA, Gurwitz JH. Drug therapy. *Lancet*, 1995, 346:32-36.
35. Vincent C, Neale G, Woloshynowych M. Adverse events in British hospitals: preliminary retrospective record review. *British Medical Journal*, 2001, 322:517-519.
36. Vincent C et al. How to investigate and analyze clinical incidents: clinical risk unit and association of litigation and risk management protocol. *British Medical Journal*, 2000, 320:777-781.
37. Mitchell P. US urged to fight "unacceptable" rate of medication errors. *Lancet*, 1999, 354:16.
38. McDonald CJ, Weiner M, Hui SI. Deaths due to medical error are exaggerated in the Institute of Medicine Report. *Journal of the American Medical Association*, 2000, 284:93-95.
39. Blendon RJ et al. Patient safety: views of practicing physicians and the public on medical errors. *New England Journal of Medicine*, 2002, 347:1933-1940.
40. Leape LL. Institute of Medicine medical error figures are not exaggerated. *Journal of the American Medical Association*, 2000, 284:95-97.
41. Lesar TS. Errors in the use of medication dosage equations. *Archives of Pediatrics and Adolescent Medicine*, 1998, 152:340-344.
42. Lesar TS. Tenfold medication dose prescribing errors. *Annals of Pharmacotherapy*, 2002, 36:1833-1839.
43. Buck ML. Preventing medication errors in children. *Paediatric Pharmacotherapy*, 1999, 5(10):1-8.

44. Kaushal R et al. Medication errors and adverse drug events in pediatric in-patients. *Journal of the American Medical Association*, 2001, 285:2114-2120.
45. Walsh KE, Kaushal R, Chessare JB. How to avoid paediatric medication errors: a user's guide to the literature. *Archives of Disease in Childhood*, 2005, 90:698-702.
46. Pate B, Stajer R. The diagnosis and treatment of blame. *Journal for Healthcare Quality*, 2001, 23:4-8.
47. Ball MJ, Douglas JVIT. Patient safety, and quality care. *Journal of Healthcare Information Management*, 2001, 16:1-6.
48. Dean B et al. Causes of prescribing errors in hospital inpatients: a prospective study. *Lancet*, 2002, 359:1373-1378.
49. Benjamin DM. Reducing medication errors and increasing patient safety: case studies in clinical pharmacology. *Journal of Clinical Pharmacology*, 2003, 43:768-783.
50. Weingart SN et al. Epidemiology of medical errors. *Western Journal of Medicine*, 2000, 172:390-393.
51. A study of physicians' handwriting as a time waster. *Journal of the American Medical Association*, 1979, 242:2429-2430.
52. Ridley SA, Booth SA, Thompson CM. Prescription errors in UK critical care units. *Anaesthesia*, 2004, 59:1193-1200.
53. *British national formulary, 2006* (<http://www.bnf.org>, accessed 12 December 2010).
54. Mehta RH, Alexander JH. Relationship of incorrect dosing of fibrinolytic therapy and clinical outcomes. *Journal of the American Medical Association*, 2005, 293:1746-1750.
55. Midlöv P et al. Medication errors when transferring elderly patients between primary health care and hospital care. *Pharmacy World and Science*, 2005, 27:116-120.
56. Fletcher KE et al. Systematic review: effects of resident work hours on patient safety. *Annals of Internal Medicine*, 2004, 141:851-857.
57. Phillips DP, Christenfeld N, Glynn LM. Increase in US medication-error deaths between 1983 and 1993. *Lancet*, 1998, 351:643-644.
58. Grissinger MC, Kelly K. Reducing the risk of medication errors in women. *Journal of Women's Health*, 2005, 14:61-67.
59. Evans RS et al. Risk factors for adverse drug events: a 10-year analysis. *Annals of Pharmacotherapy*, 2005, 39:1161-1168.
60. Metlay JP et al. Medication safety in older adults: home-based practice patterns. *Journal of the American Geriatrics Society*, 2005, 53:976-982.
61. *Adherence to long-term therapies: evidence for action*. Geneva, World Health Organization, 2003.
62. Johnell K et al. Individual characteristics, area social participation, and primary non-concordance with medication: a multi-level analysis. *BMC Public Health*, 2006, 6:52.
63. Buchanan TL, Barker KN. Illumination and errors in dispensing. *American Journal of Hospital Pharmacy*, 1991, 48:2137-2145.
64. Koren G, Haslam RH. Paediatric medication errors: predicting and preventing ten fold disasters. *Journal of Clinical Pharmacology*, 1994, 34:1043-1045.
65. Malone DC et al. Pharmacist workload and pharmacy characteristics associated with the dispensing of potentially clinically important drug-drug interactions. *Medical Care*, 2007, 45:456-462.
66. Ferner RE. Medication errors that have led to manslaughter charges. *British Medical Journal*, 2000, 321:1212-1216.
67. Hebert PC, Levin AV, Robertson G. Bioethics for clinicians: 23. Disclosure of medical errors. *Canadian Medical Association Journal*, 2001, 164:509-513.
68. Soumerai SB, Lipton HL. Evaluating and improving physician prescribing. In Strom BL, ed. *Pharmacoepidemiology*, 2nd, ed. London, John Wiley, 1994.
69. Buurma H et al. Evaluation of the clinical value of pharmacists' modifications of prescription errors. *British Journal of Clinical Pharmacology*, 2004, 58:503-511.
70. Helling DK. Implementing yesterday's promises. *American Journal of Health-System Pharmacy*, 2000, 57:576-581.
71. Kelly WN. Potential risks and prevention, Part 4: reports of significant adverse drug events. *American Journal of Health-System Pharmacy*, 2001, 58:1406-1412.
72. Millonig MK, Jackson TL, Ellis WM. Improving medication use through pharmacists' access to patient-specific health care information. *Journal of the American Pharmaceutical Association*, 2002, 42:638-645.
73. Fertleman M, Barnette N, Patel T. Improving medication management for patients: the effect of a pharmacist on post-admission ward rounds. *Quality and Safety in Health Care*, 2005, 14:207-211.
74. Cavell GF et al. Attitudes of community pharmacists towards medication error reporting. *International Journal of Pharmacy Practice*, 2001, 9 (Suppl.):R64.
75. Leape L et al.; ADE Prevention Study Group. Systems analysis of adverse drug events. *Journal of the American Medical Association*, 1995, 274:35-43.
76. Ferner RE. Medicines management: a sour taste. *Quarterly Journal of Medicine*, 2002, 95:181-184.
77. Jaski ME et al. Medication review and documentation in physician office practice. *Effective Clinical Practice*, 2000, 3:31-34.
78. Cox AR et al. Adverse drug reactions in patients admitted to hospital identified by discharge ICD-10 codes and by spontaneous reports. *British Journal of Clinical Pharmacology*, 2001, 52:337-339.
79. Ashcroft DM, Quinlan P, Blenkinsopp A. Prospective study of incidence, nature and causes of dispensing errors in community pharmacies. *Pharmacoepidemiology*, 2005, 14:327-332.
80. Westfall JM et al. Applied strategies for improving patient safety: a comprehensive process to improve care in rural and frontier communities. *Journal of Rural Health*, 2004, 20:355-362.
81. Capuzzo M et al. Reporting of unintended events in an intensive care unit: comparison between staff and observer. *BMC Emergency Medicine*, 2005, 5:3.
82. Barber ND, Dean BS. The incidence of medication errors and ways to reduce them. *Clinical Risk*, 1998, 4:103-106.
83. Dean BS, Barber ND. A validated, reliable method of scoring the severity of medication errors. *American Journal of Health-System Pharmacy*, 1999, 56:57-62.
84. Morris CJ et al. Preventing drug-related morbidity: determining valid indicators. *International Journal for Quality in Health Care*, 2002, 14:183-198.
85. Magnus D, Rodgers S, Avery AJ. GPs' views on computerized drug interaction alerts: questionnaire survey. *Journal of Clinical Pharmacy and Therapeutics*, 2002, 27:377-382.
86. Elson B. Electronic prescribing in ambulatory care: a market primer and implications for managed care pharmacy. *Journal of Managed Care Pharmacy*, 2001, 7:115-120.
87. Upperman JS et al. The impact of hospital-wide computerized physician order entry on medical errors in a paediatric hospital. *Journal of Pediatric Surgery*, 2005, 40:57-59.
88. Wilson T, Sheikh A. Enhancing public safety in primary care. *British Medical Journal*, 2002, 324:584-587.

89. Anderson S, Wittwer W. Using bar-code point-of-care technology for patient safety. *Journal for Healthcare Quality*, 2004, 26:5-11.
90. Grotting JB et al. *The effect of barcode-enabled point of care technology on medication administration errors*. Solana Beach, California, Bridge Medical, Inc., 2001.
91. Johnson KB et al. The effect of computer-assisted prescription writing on emergency department prescription errors. *Academic Emergency Medicine*, 2002, 9:1168-1175.
92. Avery AJ et al. Identifying and establishing consensus on the most important safety features of GP computer system: e-Delphi study. *Informatics in Primary Care*, 2005, 13:3-12.
93. Nebeker JR, Barach P, Samore MH. Clarifying adverse drug events: a clinician's guide to terminology, documentation, and reporting. *Annals of Internal Medicine*, 2005, 140:795-801.
94. Morrison-Griffiths S et al. Reporting of adverse drug reactions by nurses. *Lancet*, 2003, 361:1347-1348.
95. Pape TM et al. Innovative approaches to reducing nurses' distractions during medication administration. *Journal of Continuing Education in Nursing*, 2005, 36:108-116.
96. Thomson DI, Oakes K. Information systems solution to medical errors. In: *Proceedings of the Annual Healthcare Information and Management Systems Society Conference and Exhibition*, New Orleans, 4-8 February 2001.
97. Ioannidis JP, Lau J. Evidence on interventions to reduce medical errors: an overview and recommendations for future research. *Journal of General Internal Medicine*, 2001, 16:325-334.
98. Thomas E. Review: some interventions are effective in reducing medical errors. *Evidence-Based Medicine*, 2001, 6:190.
99. Weingart SN et al. Lessons from a patient partnership intervention to prevent adverse drug events. *International Journal for Quality in Health Care*, 2004, 16:499-507.
100. Dowell D et al. Urban outpatient views on quality and safety in primary care. *Healthcare Quarterly*, 2005, 8:2-8.

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